ELECTRONICS & TECHNOLOGY TODAY!

CANADA'S MAGAZINE FOR HIGH-TECH DISCOVERY

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New series beginning this issue:

THE HISTORY OF ELECTRICITY

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1991 Desktop & Networking Update

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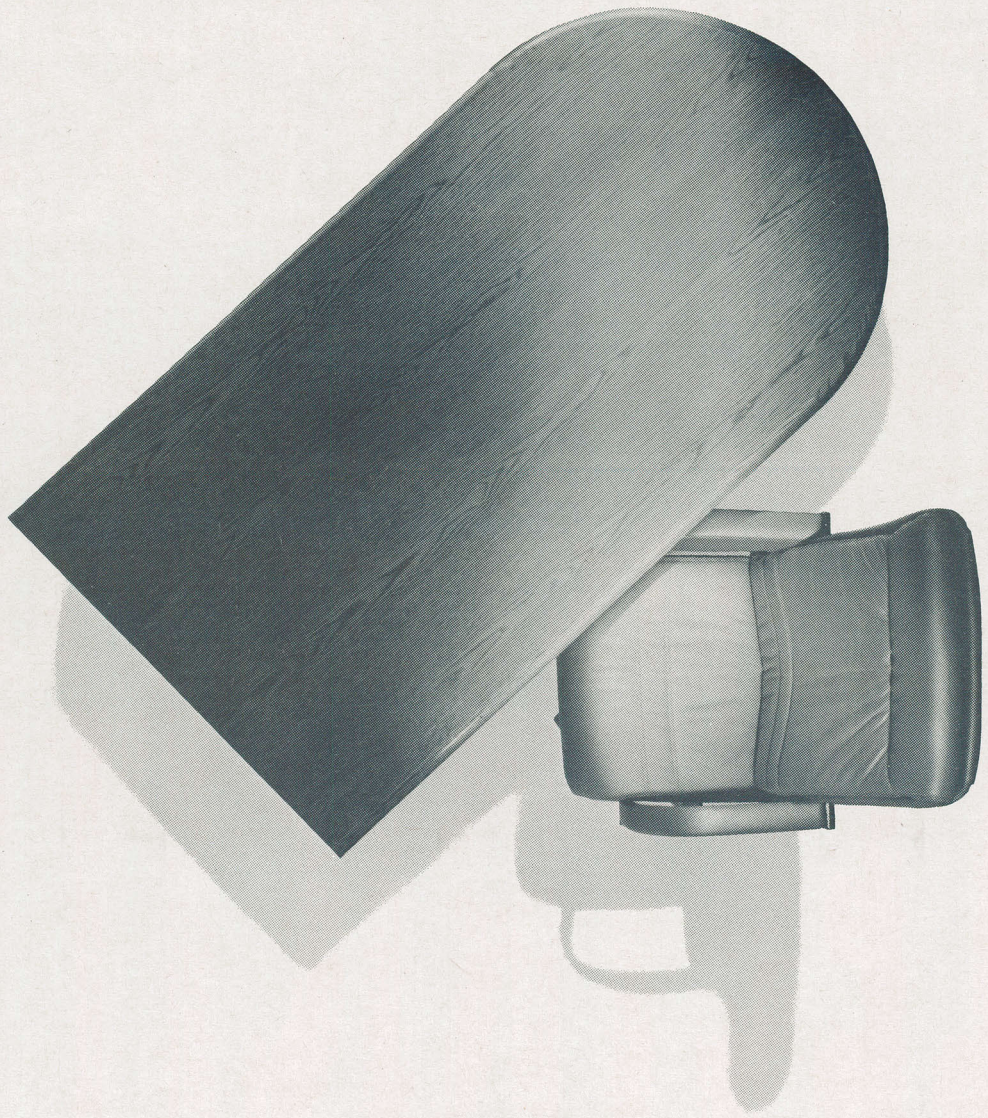

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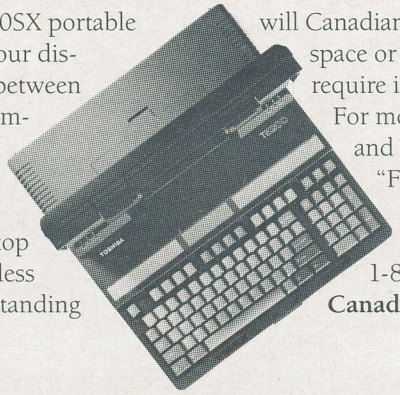

For more information about our exciting new T5200C and T3200SXC colour portables or any of Toshiba's "First Family" of quality microcomputer products, contact your nearest Toshiba Authorized Canadian Re-Seller or call Toshiba direct at 1-800-387-5645.

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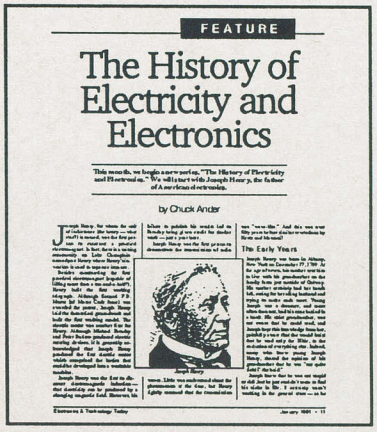
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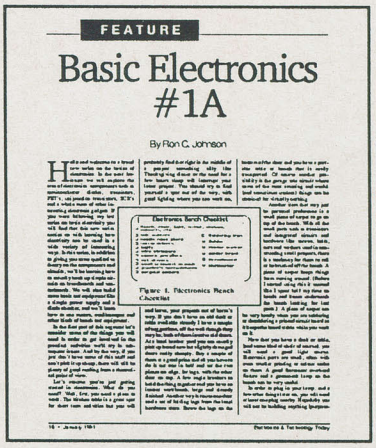
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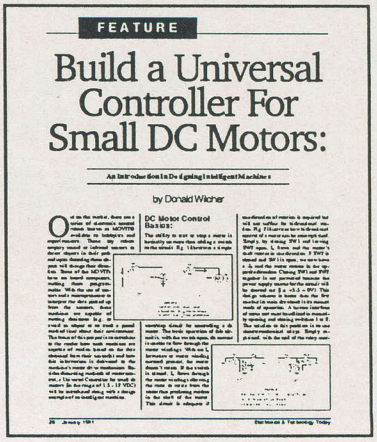
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WORKING LATE

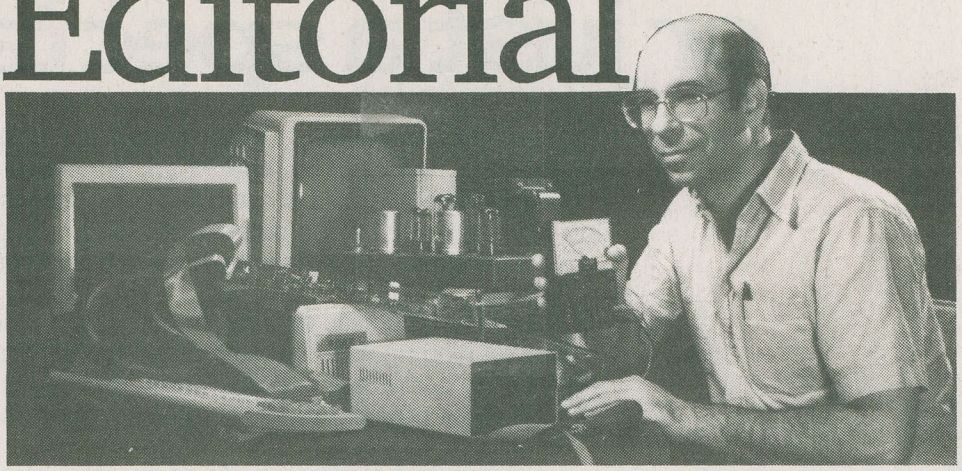
''Well, that's done. Feel like stopping off for a drink when we leave?''

''Thanks, but I'll save it for home. I'm driving tonight.''

Seagram

P.O. Box 847, Station H, Montreal, Quebec, H3G 2M8

Editorial



Happy New Year to all our readers! I hope you had a wonderful holiday season. January 1991 will be a new start for *Electronics and Technology Today*. We will, with this issue, commence a new series entitled, "The History of Electricity and Electronics." I hope you enjoy it. By learning of the history of our field of endeavour, we can, I feel, come to a deeper understanding and appreciation of the fascinating discipline of electricity and electronics.

So let's have a great year and (as I always say) if you have any letters, questions, article submissions or whatever, please don't hesitate to send them in.

Chuck Ander
Editor

ELECTRONICS & TECHNOLOGY TODAY!
CANADA'S MAGAZINE FOR HIGH-TECH DISCOVERY

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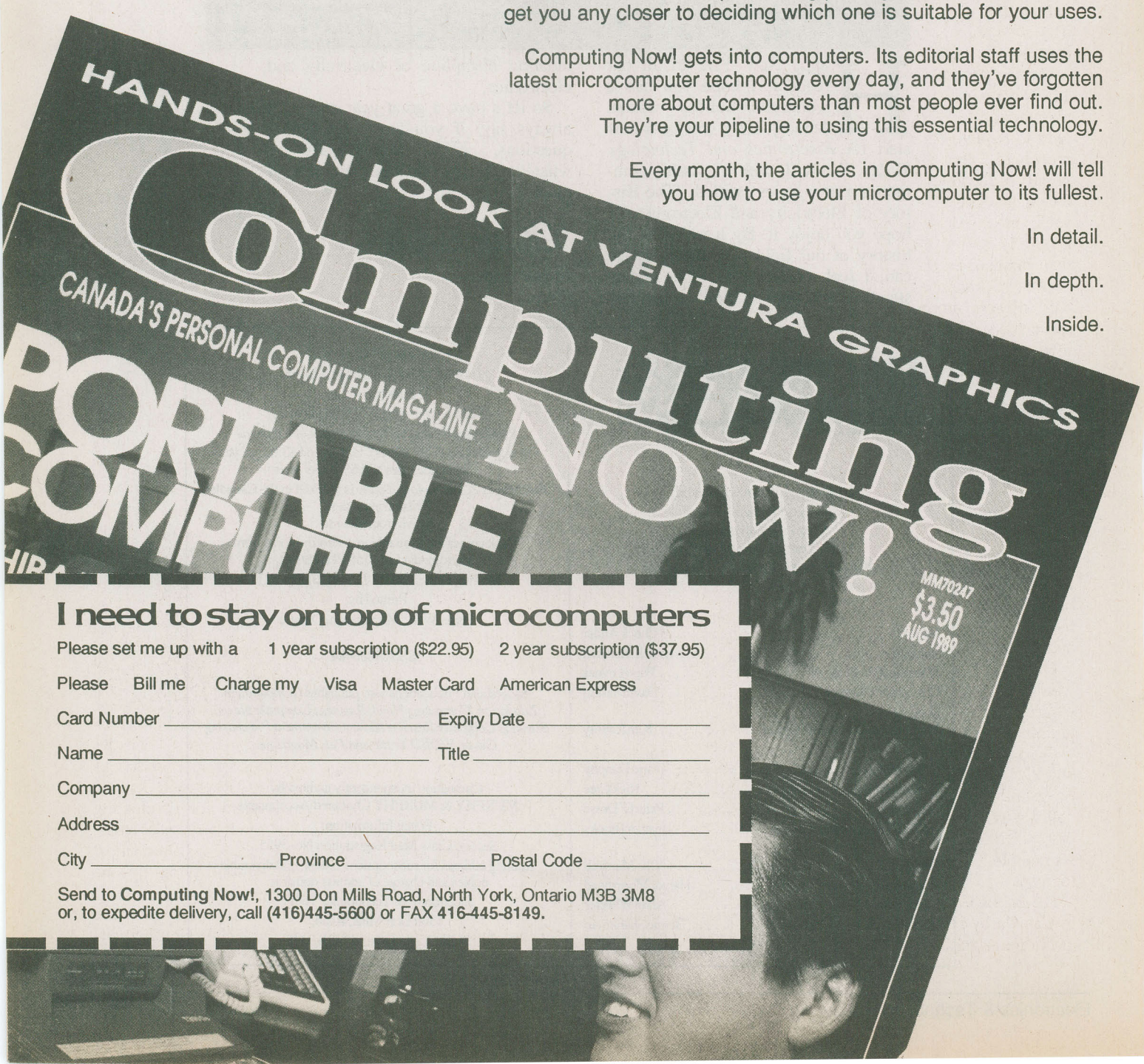

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New Products

Philips ECG Develops Four New Environment-Conserving Chemicals

Montreal, Quebec — Philips ECG has introduced four new industrial chemicals to help conserve the environment. The chemicals are part of its Hi-Tech Aerosol Chemical line.

Products OZ-100, OZ-600 and OZ-1100 contain no chlorofluorocarbon compounds (CFCs), chemicals which tend to deplete ozone in the upper atmosphere. The OZ-300 solvent has greatly reduced levels of CFSs. All our chemicals contain an advanced new agent, meet federal regulations and are generally more functionally effective than standard products.

OZ-100 is a circuit refrigerant used to chill objects more quickly with less spray than standard products. It is an inert, high-purity freezing agent of low toxicity, which cools instantly and vaporizes completely without leaving a residual film.

OZ-300 is an all-purpose electronics degreaser and removes both organic and ionic soils. It quickly flushes away deposits of dirt, grease, oxidation and particulates from electronic components, circuits, magnetic tape heads, disks, tape, film, optic devices and equipment. The chemical leaves no residue, is nonflammable, and safe for use on most plastics, elastomers, metals and paints.

OZ-600 is a heavy-duty flux remover which quickly removes most rosins and organic flux oils and ionic contaminants, leaving no white residue.

OZ-1100 is a jet air cleaner which quickly removes dust, lint, oxide particles and other dry contaminants from delicate equipment and hard-to-reach places. It dries completely, is inert, nonflammable, non-abrasive and of low toxicity.

Philips ECG products are distributed in Canada by ECG Canada, a division of Philips Associated Holdings Inc. For the name of the nearest ECG distributor, contact ECG Canada, 1928 St. Regis Boulevard, Dorval, Quebec H9P 1H6, Tel: (514) 685-5800.

Circle Reader Service Card No.9

Surecharge Introduces New Conditioner/ Charger for Motorola™ 8000 Portable Cellular Telephones

Surecharge Industries Inc. is pleased to introduce the latest addition to the **Discovery Battery Conditioning System** product line. The MC-01 is a consumer targeted, Nickel-Cadmium battery conditioner/charger, designed for use with the Motorola™ 8000, 950, Ultraclassic™ and other compatible cellular telephones. The MC-01 is the first in a series of consumer targeted conditioner/rapid chargers planned by Surecharge. All Surecharge products use the patented Discovery Battery Conditioning System circuitry which automatically conditions and rapid charges Ni-Cd batteries. The Discovery System is the only consumer targeted, battery conditioning system available.

The MC-01 has a suggested retail price of $199.00, which is very competitive with rapid chargers that don't have conditioning systems. Early in the new year, Surecharge will be unveiling a family of Discovery System chargers for a wide range of portable cellular telephones and other Ni-Cd powered electronics.

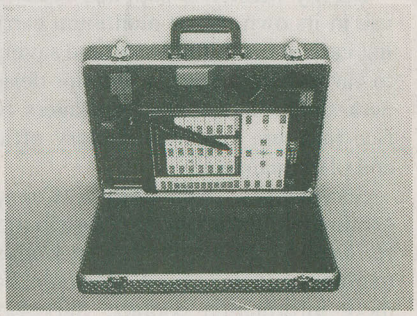
The conditioning process developed by Surecharge increases the life expectancy of Ni-Cd batteries by at least 5 times. The system not only extends battery life, but also ensures delivery of 100% of the rated energy each and every time the battery is conditioned. Even batteries with reduced capacity can be rejuvenated automatically by the Discovery System. The big environmental bonus is that rechargeable batteries won't be discarded prematurely. Surecharge's technology could potentially save millions of Ni-Cd batteries from early disposal each year.

For more information contact: Surecharge Industries Inc., (604) 876-6710 Fax: (604) 867-9229

Circle Reader Service Card No.10

Survey Master, Unique System for Surveying

Surveying Technology (Canada) Limited is pleased to announce a unique new system for conducting building measurement surveys and committing existing building drawings to CAD.



Surveying Technology (Canada) Limited based in Calgary, announces the launch of Survey Master in Canada, a unique new system for conducting building measurement surveys or transferring existing drawings into most CAD systems without tying up the computer terminal.

Survey Master consists of a portable computerized kit which is simplicity it-

self to use, enabling the operator to carry out existing building measurement surveys quickly and with a vastly reduced error factor.

Measurements are taken by using the specially designed bar code menu and light pen which eliminates the need for any key entering. Data is automatically transferred into a Psion Organizer Handheld Computer. At the completion of the survey the computer will calculate the closing error. Finding an error factor at this stage allows the operator to review and revise measurements on-the-spot without the need of a return visit.

On return to the office data can be downloaded into a CAD system and the drawing prepared within minutes. The drawing is produced using a layering convention with symbols. Survey Master is compatible with Autocad and Autocad AEC, Generic Cad, Cadvance, Integraph Microstation on the PC and Intergraph for the Mac, Intergraph Unix, Drafix, Fastcad and AG Cad. Survey Master will soon support IBM Cad.

For entering existing building drawings into a CAD system, a technician can sit at his desk, read the drawing and enter the data into the Psion Organizer using the light pen (wand) and bar code menu. Once completed the drawing can be downloaded directly into the CAD system. This allows the operation to be carried out away from the computer workstation, which can then be used for more lucrative designing.

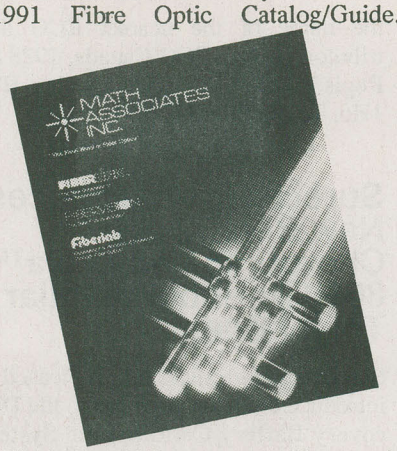
Survey Master is supplied ready to use in its own robust aluminum carrying case. It can offer great time savings to surveyors, architects, interior designers, shop fitters, facility managers, office furniture suppliers, factory office and plant managers.

Surveying Technology (Canada Limited will be appointing distribution for Survey Master throughout Canada to give complete national coverage. For more information contact: Surveying Technology (Canada) Limited, Suite 630, Atrium II, 840-6 Avenue S.W., Calgary, Alberta T2P 3E5, Tel: (403) 266-0275 Fax: (403) 265-8484.

Circle Reader Service Card No.11

The Most Comprehensive Fibre Optics Catalog Guide in the Industry

Math Associates, Inc. of Westbury, NY announces the availability of its new 1991 Fibre Optic Catalog/Guide.

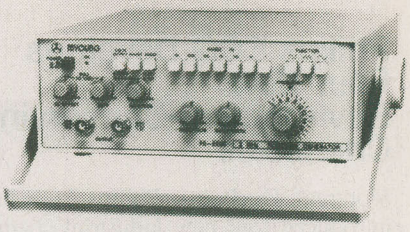


Within its 112 pages are fibre optic transmission systems to transmit analog, digital, video, RGB, audio, RS-232, RS-422, RS-485, Ethernet, FDDI, 4/20ma. current loop contact closures and telecommunication signals. Also contained is a comprehensive selection of fibre optic terminating and finishing materials, splicing equipment, cable enclosures and a wide range of test equipment. A selection of educational and instructional material will be of interest to both the expert as well as novice in this new technology. Everything needed to design, install and maintain a fibre optic transmission system can be found in this new catalog. For more information contact: True North Technology, 100 Westmore Drive, Suite 12E, Rexdale, Ontario M9V 5C3 Tel: (416) 744-2233.

Circle Reader Service Card No.12

ZTEST MYOUNG FG-2000 2 Mhz Sweep/Function Generator

ZTEST Electronics Inc. is pleased to announce the introduction of the MYOUNG FG-2000 2 MHz Sweep/Function Generator. Myoung is a leading South Korean electronics manufacturer. They have recently introduced a new line of low cost test equipment, including the FG-2000, multimeters and reciprocal frequency counters. The Myoung FG-2000 is a 2 MHz Sweep/Function Generator with 5 waveforms: Sine, Square, Triangle, Pulse (TTL) and Ramp. It can provide swept waveforms via the internal ramp



and can be frequency modulated (FM or VCG). It has DC offset capability, a X20 attenuator and a variable symmetry control. It supplies 20 V P-P into an open circuit and 10V P-P into 50 ohms.

A two year warranty completes the attractive package with a list price of the FG-2000 of C$449. Dealer enquiries are welcomed.

ZTEST Electronics Inc. is a manufacturer of ATE Test Equipment in Mississauga, Ontario. F or more information contact: ZTEST Electronics Inc., 1305 Matheson Blvd, Mississauga, Ontario L4W 1R1 Tel: (416) 238-3543 Fax: (416) 238-1377.

Circle Reader Service Card No.13

FL500 Underground Cable and Fault Tracer

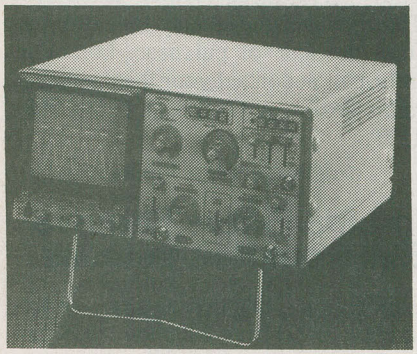
RCC Electronics is pleased to announce the FL500 underground cable and fault tracer by PCI. The development of FL500 boasts a cost effective method of tracing a single insulated wire or cable buried underground with other wires and cables in the same trench. This unit will work on underground systems for both low and high voltage power lines as well as telephone and other shielded communication cables such as co-ax and fibre-optic cables.

The FL500 contains a rechargeable battery and 120V charger. In addition, the system kit contains a 25ft external battery cord with clips that allow the user to hook onto a 12V battery. For more information contact: RCC Electronics, 310 Judson Street, Unit 19, Toronto, Ontario M8Z 5T6 Tel: (416) 252-5094 Fax: (416) 252-3031.

Circle Reader Service Card No.14

Excellence in 40MHz Oscilloscope from GW Instruments

GW Instruments continues to offer excellence in their newly increased line of oscilloscopes. Typical of the excellence offered by GW Instrument is their 40MHz Triggering Dual Trace Oscilloscope Model G0S643.



Full-featured, the G0S643 provides superb performance, reliability and design features such as, 1mV sensitivity, DC- 40MHz bandwidth, 8.8nS rise time, 2uS 5mS delay time, 12KV accelerating voltage and delayed sweep/delayed line.

The GW Instrument G0S643 offers both Chopped and Alternate Modes of operation. For low frequency work the Chopped mode is normally preferred, where the Alternate mode will be of value as high frequency is used.

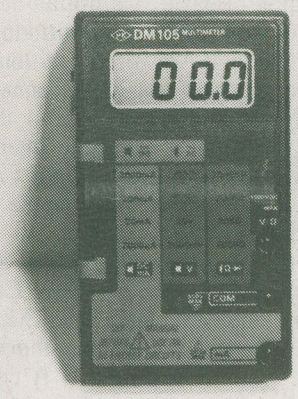
GW Instruments also produces a line of 100 MHz, 40 MHz and 20 MHz oscilloscopes, some with cursor readout (G0S645/625).

GW Instruments is represented in Canada by Duncan Instruments Canada, a leading manufacturers' representative for a wide range of test equipment. For more information contact: Duncan Instruments Canada Ltd., 121 Milvan Drive, Weston, Ontario M9L 1Z8 Tel: (416) 742-4448 Fax: (416) 749-5053.

Circle Reader Service Card No.23

DM 105 Digital Multimeter

KB Electronics announces the addition of the DM 105 Digital Multimeter to its line of electronic test equipment. This low-cost pocket-sized unit provides maximum value for your DMM dollar. The instrument features a 3.5 inch digit LCD display; measures DC volts to 1000V, AC to 750 V, DC current to 2A and resistance to 200K ohms. Its sturdy construction virtually guarantees a long working life, and efficient circuitry



promotes long battery life. With a net weight of about 7 oz. (200 g) it is the ideal handheld meter. For more information contact: KB Electronics, 1428 Speers Road, Unit 8, Oakville, Ontario L6L 5M1 Tel: (416) 847-8588 Fax: (416) 847-8598.

Circle Reader Service Card No.24

Low Cost Logic Analyzer

Thandar Electronics is pleased to announce a new low-cost Logic Analyzer.

The TA-1000 is a high-performance, low-cost portable logic analyzer for development, production, training and field service applications. It can capture data across 32 channels (at 25 MHz) and display the information in timing or list formats on the integral 7^2 inch CRT. Multilevel triggering and 5 internal clocks, with qualifiers for active high, low or don't care selection are also incorporated.

All functions are accessed through easy-to-follow soft-key controlled displays with minimal key strokes allowing this model to be used by either an experienced or novice operator. Two cursors and a fixed-trigger marker are also incorporated to allow direct readout of absolute and relative store positions.

Display formats include binary, octal, hex, decimal and ASCII, while search and compare features are also standard.

IEEE-488 and centronics interfaces are standard as is non-volatile storage of data and set-ups. Disassemblers for popular 8-bit and 16-bit microprocessors are optional. For more information contact: Omnitronix Ltd., 2410 Dunwin Drive, Unit 4, Mississauga, Ontario L5L 1J9 Tel: (416) 828-6221 Fax: (416) 828-6408.

Circle Reader Service Card No.25

Soldering Iron Controller Makes Tip Temperature Adjustable

An inexpensive adapter that makes any fixed temperature soldering iron fully adjustable from 150°F to full heat is available from M.M. Newman Corporation of Marblehead, Massachusetts.

The Dial-Temp Soldering Iron Controller is a compact device that plugs into a 115 VAC wall outlet and accepts any 3-prong fixed temperature soldering iron. Featuring a dial on top, it lets users adjust tip temperatures from 150°F to full heat.

Compatible with any soldering iron ranging from 15 to 1600 Watts, the Daily-Temp Soldering Iron Controller is ideal for precision assembly electronic work on heat sensitive components and fits neatly into a tool kit for field service applications. The controller sells for $29.95 (list). For more information contact: M.M. Newman Corporation, Charles F. Loutrel, Sales Manager, 24 Tioga Way/P.O. Box 615, Marblehead, MA 01945 U.S.A. Tel: (617) 631-7100 Fax: (617) 631-8887.

Circle Reader Service Card No.26

pLOGIC Ships: New Software Learns Patterns in Data, Makes Instant Decisions Automatically

pLOGIC Knowledge Systems, Inc. announced that it is shipping pLOGIC, the new statistical pattern recognition software for IBM 386-based PCs and compatibles.

pLOGIC is a unique mathematics-based program that recognizes patterns in data and can predict with incredible accuracy when such patterns will occur again. Designed for business and industrial applications, pLOGIC is completely menu-driven for ease of learning and use. pLOGIC is a complete decision machine that leapfrogs the current generation of decision support tools. At first glance, pLOGIC might be confused with artificial intelligence tools, such as expert systems or neural networks, that have tried to address similar problems in the past. But here's a major difference: There's nothing artificial about pLOGIC. It's based strictly on mathematics and information theory. This gives it tremendous advantages.

Since it's based on mathematics, pLOGIC is indifferent to the application itself; it is perfectly problem independent. It's equally at home approving credit applications, reviewing medical records or x-rays, forecasting sales, doing quality assurance testing or process control or valuating insurance risks — or any other problem dealing with uncertainty or probability.

pLOGIC's PC Edition requires an IBM 386-based PC or compatible, math coprocessor, 2 megabytes extended memory and DOS 3.1 or higher. It supports ASCII, Binary, Lotus 1-2-3/Symphony and dBASE III or higher files. The PC Edition has a suggested retail price of $995. A Sun (SPARC) version should be available at the time of writing. For more information contact: pLOGIC Knowledge Systems, Inc., 23133 Hawthorne Blvd., Torrance, CA 90505 Tel: (213) 378-3760.

Circle Reader Service Card No.27

GGTE Introduces Morse Tutor — Advanced Edition

Huntington Beach, Calif. — GGTE, a Huntington Beach, California-based software company, has introduced Morse Tutor - Advanced Edition, a software program that helps amateur radio operators ('hams') obtain their license by teaching them the international Morse Code. Morse Tutor - Advanced Edition also helps hams increase their speed.

According to Warren I. Hoffn ung, president, GGTE (and an Extra Class amateur radio operator), the Morse Tutor - Advanced Edition, is comprised of four separate modules: 1) A complete and enhanced copy of the Morse Tutor program; 2) An automatic random QSO (conversation) generator that may be used by students, instructors and volunteer examiners; 3) A unit allowing users to create QSOs, exams, or practice copy for characters difficult to master; and 4) A module enabling users to import a text file created with the program or with any word processor allowing users to save wok as a text (unformatted ASCII) file.

"Morse Tutor - Advanced Edition is flexible and fast," Hoffnung said. "Users can tailor the 12 self-paced lessons to their skill level and select various code speeds, modes, and audio frequencies. They can also create their own drills, practice or actual exams which conform to FCC requirements. Many users of the original Morse Tutor (which has sold more than 7,000 copies worldwide to date) reported passing their five word-per-minute Novice test in less than two weeks. With the new product, they will probably do even better."

Morse Tutor - Advanced Edition requires 235K bytes of free memory and is compatible with the IBM PC Jr, PC, XT, AT or PS/2, including jPlasma and LCD laptops. Modules which include printing analyses and QSOs support laser and dot-matrix printers.

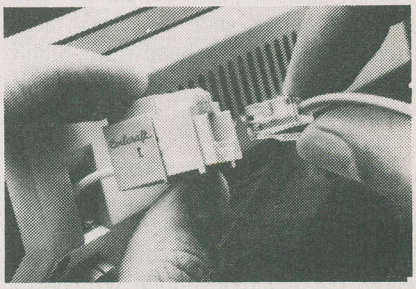
Morse Tutor - Advanced Edition supports either the standard or Farnsworth mode (a method which speeds learning by increasing the separation between characters and words while preserving overall word speed, thereby focusing on comprehending the Morse Code characters by sounds and rhythms rather than by the number of 'dits' and 'dahs'). Within each lesson, new Morse Code characters are introduced with on-screen flashcards; random characters are sounded and displayed in five character groups; and random words provide an effective review of all characters that have been learned.

The suggested retail price for Morse Tutor - Advanced Edition is $29.95. This includes free updates for a full year from the date of purchase. For more information contact your local amateur radio dealer or GGTE at (714) 968-1571.

Circle Reader Service Card No.28

In-Line Filters Remove EMI from Phone Lines

Eliminating electromagnetic interference (EMI) from telephone lines can be done quickly and easily using new in-line filter modules from Coilcraft.



They're designed to help meet FCC Part 15 and 68 as well as European CCITT and CISPR-22 requirements. The filters provide greater than 30 dB attenuation of EMI over the 5 kHz to 10 MHz range (20 dB attenuation from 100 kHz to 110 MHz). Isolation is 1000 V between windings, and DC resistance per winding is 65 MOhms.

Coilcraft EMI filters are available in 2 or 4 line versions for RJ-11, RJ-14, and RJ-45 cables. One end plugs into the line or handset while a jack at the other end receives the cable. For telephone equipment manufacturers, Coilcraft also offers discrete filters for circuit board installation.

Coilcraft's 4 line RJ-14 filters cost less than $12 each in 500 quantities. For more information contact: Paul Liebman, Coilcraft, 1102 Silver Lake Road, Cary IL 60013 Tel: (708) 639-6400. ❐

Circle Reader Service Card No.29

FEATURE

The History of Electricity and Electronics

This month, we begin a new series, "The History of Electricity and Electronics." We will start with Joseph Henry, the father of American electronics.

by Chuck Ander

Joseph Henry, for whom the unit of inductance (the henry — what else?) is named, was the first person to construct a practical electromagnet. In fact, there is a mining community on Lake Champlain named port Henry where Henry's invention is used to separate iron ore.

Besides constructing the first practical electromagnet (capable of lifting more than a ton-and-a-half!), Henry built the first working telegraph. Although Samuel F.B. Morse (of Morse Code fame) was awarded the patent, Joseph Henry laid the theoretical groundwork and built the first working model. The electric motor was another first for Henry. Although Michael Faraday and Peter Barlow produced electric rotating devices, it is generally acknowledged that Joseph Henry produced the first electric motor which comprised the basics that could be developed into a workable machine.

Joseph Henry was the first to discover electromagnetic induction — that electricity can be produced by a changing magnetic field. However, his failure to publish his results led to Faraday being given credit for similar work — just a year later.

Joseph Henry was the first person to demonstrate the transmission of radio waves. Little was understood about the phenomenon at the time, but Henry rightly assumed that the transmission was "wave-like." And this was over fifty years before similar revelations by Hertz and Marconi!

Joseph Henry

The Early Years

Joseph Henry was born in Albany, New York on December 17, 1799. At the age of seven, his mother sent him to live with his grandmother on the family farm just outside of Galway. His mother certainly had her hands full, caring for her ailing husband and trying to make ends meet. Young Joseph was a dreamer, and more often than not, had his nose buried in a book. His strict grandmother, was not aware that he could read, and Joseph kept this knowledge from her, painfully aware that she would insist that he read only the Bible, to the exclusion of everything else. Indeed, many who knew young Joseph Henry, shared the opinion of his grandmother that he was "not quite richt i' the haid."

Joseph knew that he was not stupid or dull, but he just couldn't seem to find his niche in life. It certainly wasn't working in the general store — as he

did in the years he lived on his grandmother's farm. And he definitely did not have a knack for watch repair, for which he was an apprentice when, at the age of thirteen, he moved back to Albany to live with his mother. (Sadly, his father died while he was living in Galway.)

One day in the watch shop, a prominent actor, John Bernard came in to inquire as to whether his watch was ready. Mr. Bernard must have been impressed with young Joseph, for he invited him to the theatre. To Joseph Henry, this sounded like the most exciting thing possible! He did not have to wait long to take Mr. Bernard up on his invitation. His boss shortly announced he was closing the store to move west — Joseph Henry was a free man!

His employment at the theatre was exciting and rewarding and, for the first time in his life, he seemed to have natural ability in something! But even this, after a while, seemed not enough. "Was it enough," he asked himself, "to do something one enjoyed and found exciting?" Apparently, the answer was no. Then something happened that would change the course of Joseph Henry's life forever.

Joseph is "Called"

While home sick one day, he came across a book entitled, *Lectures on Experimental Philosophy, Astronomy and Chemistry, intended chiefly for the use of students and young persons*, by G. Gregory, D.D., Vicar of West-Ham, published in London in 1808. Thumbing through it, Joseph paused at a paragraph: "You throw a stone, or shoot an arrow upward into the air; why does it not go forward in the line or direction that you give it? Why does it stop at a certain distance, and then return to you? What force is it that pulls it down to the earth again? On the contrary, why does flame or smoke always mount upwards, though no force is used to send them in that direction?"

Joseph sat down by the window and began to read. Only when dusk made it too dark to see did he put the book down again.

His mind was working feverishly. Yet he could see clearly and sharply, as he rarely did in his everyday pursuits. A new door had been opened to Joseph. He had never read anything like it before. Of course, it was all true — the laws of the universe that were forever the same, explaining the unexplainable. In a sudden burst of self-awareness, Joseph saw with absolute clarity that he must find some way to spend his life dealing with the kind of truth that lay in his lap. What mattered was the existence of the changeless physical laws — and he must become one of the people who explored and explained and learned how to use them.

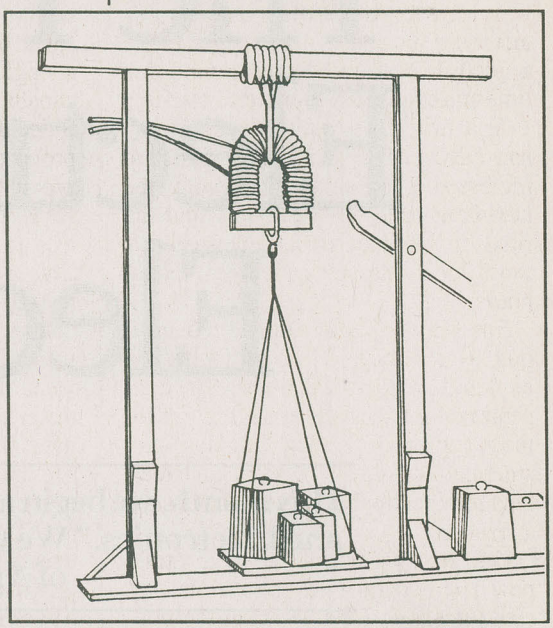
He knew he was "called" to this wonderful new pursuit. No wonder he was labelled as "unteachable" by his school teacher. He had just not been able to endure the drill-and-rote method of teaching which was the only way his teacher could imagine an eight-year-old managing to learn something. What his mind had needed was a chance to leap ahead, and a teacher to free it. Stupid? Dull-witted? "I'm not!" Joseph thought, clutching his new book. "I'm not! I've only been in the wrong place — and I'm not any longer!"

Years later, Joseph Henry, the scientist came across the volume in his library. He then inscribed on its flyleaf:

This book, by no means a profound work, has under Providence exerted a remarkable influence upon my mind. It accidentally fell into my hands when I was about sixteen years old, and was the first book I ever read with attention. It opened to me a new world of thought and enjoyment; fixed my attention upon the study of nature, and caused me to resolve at the time of reading it that I would immediately devote myself to the acquisition of knowledge.

School Days

So at age sixteen, Joseph Henry knew the path he wanted to take in life. His first requirement was education. He hesitatingly approached Dr. T. Romeyn Beck, the Director of the Albany Academy, enquiring about attending that institution. Although unqualified, his youthful enthusiasm so impressed Dr. Beck, he agreed to take him on as a special student. Joseph, studying night and day, completed the equivalent of a four-year high-school course in seven months. When Joseph's small fund of money began to run out, Dr. Beck found him a teaching job to help him with expenses. For three years Joseph taught in a one-room school near Albany, earning fifteen dollars a month. Every evening he studied at the Academy, taking advanced classes in mathematics and "natural philosophy," as chemistry and physics were then called. He swallowed knowledge as though he were starving for it, and his teachers continued to be awed at his brilliance and retentive powers.



Henry's Electromagnets Could Lift Over One Ton!

In 1824, Dr. Beck invited Joseph Henry to join the Albany Institute of Science and Art. This Institute was a society of teachers and amateur scientists that met weekly for scientific lectures and demonstrations. The meetings were open to the public for a small admission fee. Joseph had often attended as a non-member. Such lectures were not merely a diversion; in those days they were an accepted form of education. In fact, an ex-bookbinder's apprentice named Michael Faraday, had gotten most of his education in this way. Joseph did well as a member and his lectures were well received. As well,

his training in the theatre gave him an excellent stage presence — which of course, helped with his presentations.

A frequent attendee at these lectures was Harriet Alexander, Joseph's fifteen-year-old cousin. They began to see a good deal of each other around this time and eventually, they were married.

In a few short years, Joseph Henry had advanced to the post of assistant professor of mathematics, with the honourary title of "professor" and the right to conduct experiments in his third-floor classroom after school hours.

For Joseph, mathematics broadened quickly into the new, almost totally unexplored field of electricity. He concentrated on it, sharing all his excitement and much brilliant thinking with students who may or may not have realized how lucky they were to have such a teacher.

One day he demonstrated a totally new innovation — a new kind of electromagnet. First showing the conventional style of electromagnet, he demonstrated that it could lift a maximum of seven pounds. This magnet was horseshoe shaped, was insulated with shellac and was wrapped around with several turns of plain wire.

"Now, your attention please," Joseph said in a commanding voice. He then held up another horseshoe-shaped magnet, a bulky one wrapped with many turns of a shiny pink material. "I have made some changes," he pointed out. "Instead of insulating the horseshoe with shellac, I've insulated the wire by wrapping it heavily with silk. Now look!"

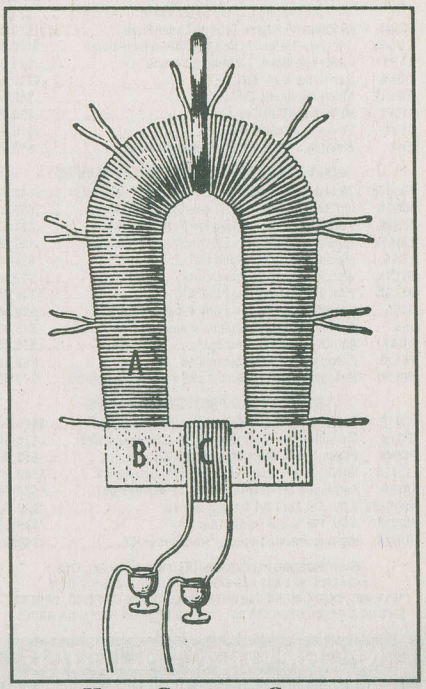
This new magnet lifted all the weights on hand — over four hundred times its own weight! Eventually, he was able to produce an electromagnet capable of lifting 3,600 pounds. Joseph Henry had invented the powerful electromagnet as we know it today.

In building the first powerful electromagnet, Henry drew on the work of William Sturgeon (1785-1850), who was a self-taught scientist and experimenter in Woolwich, England. He built, in 1824, the first lifting magnet, capable of holding nine pounds. Henry first found that he could lift more weight by simply adding to the number of turns or wire. To do this, he insulated the wire instead of the magnet. But adding turns worked only to a point. Then he had to add pairs of plates to his battery to keep up the current. More wire increased the resistance of the circuit, requiring more cells. But by using multiple coils connected in parallel, he found he could get a superior result with a single battery of large plate area (one capable of delivering high current). Since the amount of magnetic flux was proportional to the current, this provided the maximum lift power. This Henry called the "quantity" magnet. He also produced the "intensity" magnet. This was formed of a single coil consisting of many turns and had to be connected to multiple battery cells in series. This arrangement was necessary when the magnet had to work at some distance from the batteries. This arrangement produced a relatively high voltage, needed to overcome the resistance of the wire from the battery to the magnet. Thus Henry's "quantity" and "intensity" magnets both anticipated the fact that the maximum magnetic force was obtained when the resistance of the magnet and that of the battery were matched.

Henry reported his results in 1831 in a paper in the American Journal of Science: *On the Application of the Principle of the Galvanic Multiplier to Electro-Magnetic Apparatus, and also to Development of Great Magnetic Power in Soft Iron with a Small Galvanic Element.*

It was not until 1837 that Henry became acquainted with Ohm's law, which would explain the relationships accounting for the operation of his "quantity" and "intensity" electromagnets. But his projections of the possibilities of these arrangements and their extension to his experiments and discoveries of the early 1830s were to establish Henry as a first-rank American scientist, and a pioneer in electrodynamics.

The concept of sending signals magnetically (the telegraph) was first suggested by Ampère. Although many experimenters tried to build a practical telegraph, the main problem was sending signals over long distances. Joseph Henry solved the problem by using an "intensity" battery, using many pairs of plates in series for the power source at the sending end, and an "intensity" magnet of many turns of small wire at the receiving end. In effect he was matching resistance for the highest efficiency of transmission. To detect the signals he used a magnet with a clapper to strike a bell. This same concept led him to develop an electromagnetic



Henry Generates Current Magnetically–The First Generator

relay for multiplying a signal.

Although Henry knew that he had assembled all the elements of a successful telegraph system, he did not make an invention of them. He was content that science had accomplished its purpose, and he left to others the extension of the scientific principles to an utilitarian end. Samuel F.B. Morse (1791-1872) developed the practical telegraph (along with the Morse Code) within a decade of Henry's work.

As soon as Oerstead had announced his discovery that electric current is accompanied by magnetism, and that the magnetism encircled the current, Faraday succeeded in assembling the first electromagnetic motor.

Faraday was followed by Peter Barlow (1776-1862), a physicist at Woolwich Academy, England, who developed an "Electromagnetic Wheel."

Contrasted to these novel but impractical devices, the electric motor constructed by Henry is credited as being the first which comprised the basics that could be developed into a workable machine. Henry described his motor in

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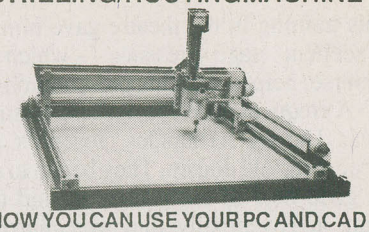

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an article in the American Journal of Science entitled, *On a Reciprocating Motion Produced by Magnetic Attraction and Repulsion*:

> I have recently succeeded in producing motion in a little machine by a power, which, I believe has never before been applied in mechanics — by means of magnetic attraction and repulsion.
>
> Not much importance, however, is attached to the invention, because the article, in its state can only be considered as a philosophical toy, although in the progress of discovery and invention, it is not impossible that the same principle, or some modification of it on a more extended scale, may hereafter be applied to some useful purpose. But without reference to its utility, and only viewed as a new effect produced by one of the most mysterious agents of nature, you will not, perhaps, think the following account of it unworthy of a place in the Journal of Science.
>
> It is well known that an attractive or repulsive force is exerted between two magnets, according as poles of different names or poles of the same, are presented to each other
>
> In order to understand how this principle can be applied to produce a reciprocating motion ...

Then Henry went on to describe the operation of his electromagnetic motor.

By 1938 Thomas Davenport of Brandon, Vermont had received U.S. Patent No. 132 on his rotary electric motor. Practical motorization, as time would show, had only to wait for the development of the dynamo.

One of the great problems of the day was that of producing electricity from magnetism. Since an electric current always produces magnetism, people reasoned that the inverse was also true. Also, since a steady current produces steady magnetism, most experiments involved wrapping wire around a magnet and looking for evidence of current produced. Henry perceived that the answer lay in a changing magnetic field. In the crucial experiment that demonstrated his hypothesis, Henry used one of his lifting magnets which he equipped with an armature wound at its central portion with 30 feet of insulated wire. The armature was placed across the poles of the magnet and the terminals of the armature winding were connected to the terminals of a galvanometer about 40 feet from the magnet.

"When this arrangement was completed," Henry reported, "I stationed myself near the galvanometer and directed an assistant to attach the galvanic battery to the magnet. At this instant the north end of the galvanometer needle was deflected 30 degrees to the west, indicating a current of electricity from the coil surrounding the armature. The effect, however appeared only as a single impulse...

"This experiment," Henry concluded, "illustrates most strikingly the reciprocal action of the two principles of electricity and magnetism, if indeed, it does not establish their absolute identity."

Henry had singled out the key element leading to an understanding of the dynamic relationship of electricity and magnetism. He had made one of the world's momentous discoveries — the electromagnetic induction of electricity by magnetism in motion. Unfortunately, his failure to publish his results led to Faraday being given credit for discovering electromagnetic induction. Joseph Henry further went on to discover the principle of self-induction. He also produced an electrical transformer capable of stepping up or down voltage and current.

Joseph Henry is the first to have demonstrated the propagation of radio waves. He showed that the induction from a single spark from the discharge of a Leyden jar (primitive glass capacitor) was penetrating enough to magnetize steel needles 30 feet away in a cellar, with two floors and ceilings intervening.

To account for the action Henry made the remarkable projection that the electricity, leaping through the space was *undulatory, or wave-like*, in nature, and was made possible by an intervening plenum, or *ether-like medium*, which transmitted the waves.

He ended his report ... "*It would appear that transfer of a single spark is sufficient to disturb perceptibly the electricity of space throughout a cube of 400,000 feet of space, and that the spark is oscillatory. It may be inferred further that the diffusion of motion in this case is comparable with that of the spark of a flint and steel in the case of light.*"

Joseph Henry's career in research came to an end when he accepted the position as the first director and secretary of the newly created Smithsonian Institute. For the rest of his life, he was devoted to the responsibilities of this position. Similarly, when the American Civil War erupted, Henry pledged the entire resources of the Smithsonian Institute in an effort to protect the Union. He was a close friend of Abraham Lincoln and used his scientific knowledge to greatly aid the Northern forces on more than one occasion.

Joseph Henry was one of those scientific pioneers in the vanguard of the age of electricity. The electronic wonders of the modern world, dependent on the discoveries of so many would not have been possible without the contributions of this pioneer. The importance of Joseph Henry's discoveries in the field of electricity were to become clear only with future developments. Marconi, many years later, was to give Joseph credit for being the first to transmit and receive signals of spark frequency at a time when no one could assess the importance of the discovery. In 1893 the standard unit of inductance — the henry — was named for him. Thus Joseph joined farad, volt, ohm and the other immortals of electronics, whose names are now household words in the English language.

The development of the modern dynamo, or generator, was dependent on the discovery shared by Henry and Faraday — the principle of induction. Faraday had taken this principle one step further than Henry — in order to have continuous current, it was necessary to have continuous motion — and built the first dynamo, a copper disk rotating between the poles of a horseshoe magnet. The first dynamos produced only direct current; they lost much power in operation and were costly. But the right person, Nikola Tesla, came along with the right questions, "Is this the best way? Is this the only way?" Tesla developed a dynamo that

see **Henry**, *page 18*

FEATURE

Basic Electronics #1A

By Ron C. Johnson

Hello and welcome to a brand new series on the basics of electronics. In the next few issues we will explore the area of electronics: components such as semiconductor diodes, transistors, FET's, unijunction transistors, SCR's and a whole mess of other interesting electronic gadgets. If you were following my last series on basic electricity you will find that this new series carries on with learning how electricity can be used in a wide variety of interesting ways. In this series, in addition to giving you some qualitative theory on the components and circuits, we'll be learning how to actually hook up simple circuits on breadboards and vectorboards. We will also build some basic test equipment like a simple power supply and a diode checker, and we'll learn how to use meters, oscilloscopes and other kinds of bench test equipment.

In the first part of this segment let's consider some of the things you will need in order to get involved in the practical activities we'll try in subsequent issues. And by the way, if you just don't have some of this stuff and can't pick it up cheap, there will still be plenty of good reading from a theoretical point of view.

Let's assume you're just getting started in electronics. What do you need? Well, first, you need a place to work. The kitchen table is a great spot for short term activities but you will probably find that right in the middle of a project something silly like Thanksgiving dinner or the need for a few hours sleep will interrupt your latest project. You should try to find yourself a spot out of the way, with good lighting where you can work on, and leave, your projects out of harm's way. If you don't have an old desk or table available already I have a couple of suggestions, off the wall though they may be; both of them involve old doors. At a local lumber yard you can usually pick up brand new but slightly damaged doors really cheaply. Buy a couple of them at a good price and all you have to do is cut one in half and set the two pieces on edge, for legs, with the other door on top. A few angle brackets to hold the thing together and you have an instant workbench, large and already finished. Another way is to use one door and a set of folding legs from the local hardware store. Screw the legs on the bottom of the door and you have a portable table or bench that is easily transported. Of course another possibility is the garage sale circuit where some of the most amazing and useful (and sometimes useless) things can be obtained for virtually nothing.

Electronics Bench Checklist

- ☐ Bench, chair, light, outlet, shelves, cabinets, etc
- ☐ side cutters
- ☐ needle nose pliers
- ☐ screw drivers
- ☐ knife
- ☐ wire strippers
- ☐ square jaw pliers
- ☐ nut drivers
- ☐ small crescent wrench
- ☐ jeweller's screwdrivers
- ☐ surgical seizers
- ☐ Soldering iron
- ☐ Solder
- ☐ Solder sucker
- ☐ solder braid
- ☐ Breadboard
- ☐ Multimeter

Figure 1. Electronics Bench Checklist

Another item that may just be personal preference is a small piece of carpet to go on top of the bench. With all the small parts such as transistors and integrated circuits and hardware like screws, bolts, nuts and washers used in constructing small projects, there is a tendency for them to roll or be brushed off the bench. A piece of carpet keeps things from moving around. (Before I started using this it seemed like I spent half my time on hands and knees underneath the bench looking for lost parts.) A piece of carpet can be very handy when you are soldering or desoldering a printed circuit board as it keeps the board stable while you work on it.

Now that you have a desk or table, (and some kind of chair of course), you will need a good light source. Electronic parts are small, often with even smaller printing or colour codes on them. A good florescent overhead fixture and a gooseneck lamp on the bench can be very useful.

In order to plug in your lamp, and a few other things later on, you will need at least one plug nearby. Hopefully you will not be building anything (purpose-

ly or by accident) which will consume large quantities of current, so a separate circuit and breaker should not be needed. If you have one, though, a plug-in bar with its own switch and breaker can be handy so everything on your bench can be turned off at once.

Next you will need a small parts cabinet with a number of individual drawers to keep electronic parts and supplies. Again the garage sale circuit can be of help. Lots of hardware stores sell them as well, often at reduced prices. Also in the way of storage space, you will need someplace to keep magazines and books that you will eventually accumulate, and a place for tools. A shelf or two, and/or a desk with drawers would help here.

What about tools? These guys are expensive if you buy decent ones and cheap tools are really a pain in the neck. You would be better to limp along with a few good basics than buy a whole set that wear out or break prematurely. What do you need?

Probably the most important hand-tool you can have for this kind of work is a pair of side cutters. What you need is a small pair, not the average type you find at the hardware store. There are several good brands, such as Cooper, or Excelite, and for a set of four inch side cutters you can easily pay twenty to thirty dollars. If this is too steep, check out Sears or Canadian Tire but find out what the warranty is. It's important. The next most important hand tool would be a pair of needle-nose pliers. Again, you need a very small pair. They are used to bend wires, hold components, and lots of other uses. After this would come screw drivers—flat, Philips and Robertson (another great Canadian invention) — a knife (either a small Xacto type or a packing crate knife), a wire stripper, square jaw pliers, a set of nut drivers, a small crescent wrench, jewellers' screwdrivers, surgical seizers. . . Of course the list could go on indefinitely, and you certainly can get started without all the things I have listed, but there are a few more that I have not listed.

On the bench itself you will need a soldering iron. Soldering irons start in the ten dollar range and go up, but for this kind of work a certain level of quality is necessary. First, it should be temperature controlled which means that there is an internal control of some kind which sets the tip temperature to a fixed temperature. In electronics, if you don't use a temperature controlled soldering iron you will very likely destroy a lot of components while you are developing your soldering technique. Soldering irons are rated in watts which indicates how much heat they can supply. If you are heating a large solder joint more wattage is required to heat the joint to the rated temperature in a given length of time. Twenty-five watts is a small iron. Forty watts is about right for general electronic soldering. Sixty watts and higher are available, and are usually used for constantly doing large solder joints such as wires to lugs, etc. Ideally your soldering iron should have a grounded tip. (You know it is grounded if the power cord has a three prong plug.) Grounded tip irons are not only safer for the person using them but they can save the destruction of certain devices which are sensitive to static discharge. As with the other tools this kind of equipment is best obtained from an electronics supplier. Radio Shack stocks a reasonable selection of this kind of equipment for the beginner.

Still on the subject of soldering, sooner or later you will need to be able to desolder parts which usually means removing as much solder from the joint as possible before disconnecting it mechanically. There are a couple of choices for this job. One is to use solder wick. Solder wick is a braid of copper which comes on a small roll. When the wick is placed between the soldering iron tip and the solder joint the molten solder will be drawn up into the wick by surface tension. The wick absorbs the solder away from the joint allowing you to disconnect the joint mechanically. This stuff works pretty well and comes in a variety of widths for various sizes of solder joints. The disadvantages are that it is consumed in use and sometimes can not draw all the solder out of plated-through holes in printed circuit boards.

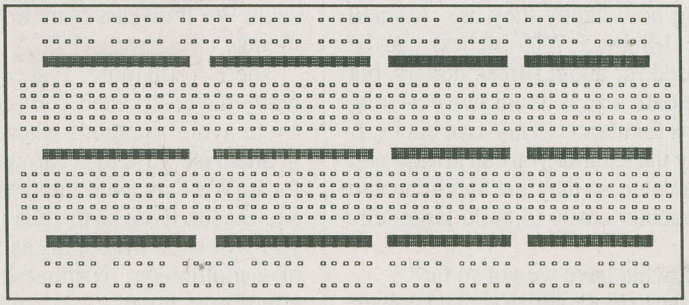


Figure 2. A solderless breadboard

The other choice is a solder 'sucker'. These come in various sizes and consist of a tube with a spring-loaded piston which, when released, creates a vacuum at the heat-resistant teflon nozzle. By melting the solder joint and then placing the nozzle over the joint and triggering the piston, the solder is sucked up into the tube. These work very well once you develop a little skill with them. They start in the ten dollar range and can go up to thirty or more. There are other devices available but the cheaper ones, such as vacuum bulbs, are not worth buying and the more expensive vacuum solder stations are for professional applications.

You will also need some solder. This stuff is not really cheap. If you buy it in larger quantities the price per unit drops but you have to consider how much you will use. We'll talk more about soldering and supplies in another issue but for now suffice it to say that you need electronic resin flux type solder, in a fairly small diameter and a good standard type is an alloy of 60% tin and 40% lead.

Soldering is not the only way to set up electronic circuits. In fact, most times you will want to breadboard the circuit to test and modify it and nobody wants to desolder and resolder the circuit every time they make a change. The answer is another tool which is practically indispensable to the hob-

byist and experimenter: a breadboard. Breadboards are flat plastic devices (See Figure 2) with a matrix of holes on top into which component leads and wires can be inserted to make connection with conductors underneath. The holes are interconnected such that you can connect more than one lead together using jumper wires and in so doing set up temporary circuits. These units are relatively inexpensive considering how handy they are. A small one (2 1/8 by 5 7/16 inches) can be purchased for about fifteen dollars, but the standard size is about twice as long and runs for about twenty-five bucks. If you buy the smaller you can always add another later as they are modular and snap together easily to build larger circuits.

Well, what have we got so far?

A place to work with light and power. Hand tools and soldering equipment, a breadboard. You can probably see already that this hobby could become somewhat expensive. On the other hand, you can start with the basics and build up from there.

What about parts, supplies and test equipment?

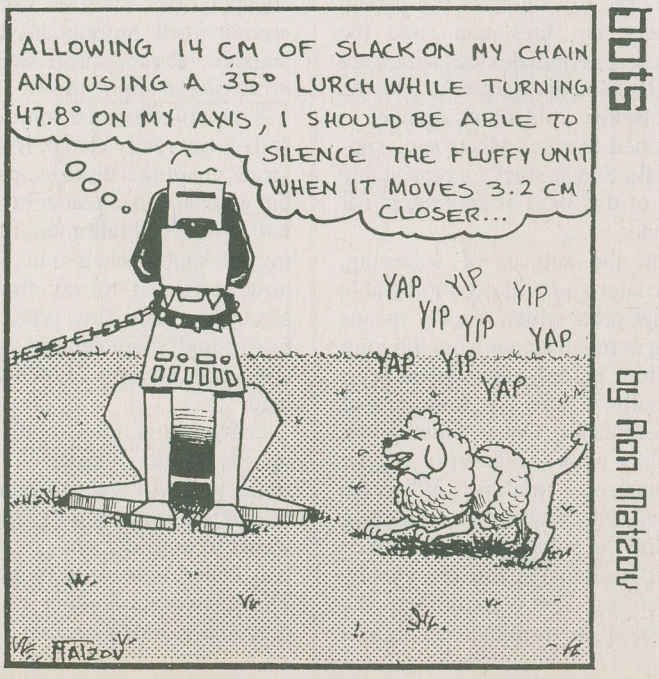
There is really no point in spending money on electronic parts before you know what you need but if you come across old televisions, stereos, etcetera that have used parts in them don't throw them away. You might be able to scrounge something out of them. Also, hardware and metal or plastic boxes to house projects are expensive. If you have anything that can serve in this capacity, hold onto it. It will save you money in the long run. Of course, as we get into this series and attempt some of these projects, you may want to scrounge or buy the more specific components required. The same applies for other supplies like wire, chemicals and such. We'll discuss them in future segments.

There is still more. Test equipment is really the costly item here, but we will try to avoid situations where you need it, or devise ways to get around the need for it. We may even build some bench equipment. Even so the one item which you will need eventually is some kind of a multimeter. Without it you'll be effectively blind in determining how your projects work.

At the low end of the spectrum you can pick up a simple analog multimeter, which will measure AC and DC voltage, low range current, and resistance for around twenty-five dollars. These units are pretty basic, not exceedingly accurate and you won't want to drop them on the floor, but they will do the job. Meters with digital readouts start at about twice that price, but don't be fooled. Just because they have a digital display does not necessarily mean that the meter is any more accurate or has better loading characteristics. For a hundred dollars or more you will get into meters with input impedances over 1 Megohm which is very desirable in the kind of measurements we will do in electronics. Autoranging is a nice feature, but not really necessary. Also, we won't be measuring large quantities of current, or if we do we can use some simple tricks to use a voltage range to accomplish it. Another consideration is some of the new digital meters which have additional features such as capacitance measuring capabilities and transistor checkers. The features all boost the price of course.

With a multimeter and some of the other tools already mentioned we will build a simple DC power supply, which is probably the next most important thing you will need. Electronic circuits generally operate using DC voltages so a variable, regulated DC power supply will be useful as we continue learning about diodes, transistors and such. Once we have the power supply there are a number of other useful circuits we can build, like a simple pulse generator, a diode checker, a sine wave generator, a simple frequency counter and lots of other interesting circuits.

So stay tuned and check out Part B of this segment where we will take a theoretical look at semiconductors. ❐



Henry, *Cont'd. from page 15*

produced alternating current, which was able to travel much greater distances without weakening. Also, it is much less costly. Alternating current was first demonstrated at the Chicago Wold's Fair in 1893.

But Joseph Henry did not live to see the demonstration at the Chicago World's Fair or the wonderful electric age which he helped to produce. He had been unwell for some months and at noon on May 13, 1878, at the age of 78, Joseph Henry woke from a deep sleep to see his family and friends gathered around his bed. He did not recognize them. Slowly he turned his head for a last look out the window at the world he loved, and asked, "What direction is the wind...?" ❐

Basic Electronics #1B

by Ron C. Johnson

In the first part of this segment we discussed what this series on Basic Electronics would be about and what you would need if you are a beginner hobbyist. I made some suggestions of things you might want in order to set up a work area and some of the tools and supplies which would be helpful. If you already have some or all of that stuff so much the better; you're ready to go.

This part is an introduction to the theory (don't shudder) behind semiconductor electronics. We will get started here with how diodes work and then next month we can try a small project. Here we go . . .

If you remember 'way back to the beginning of Basic Electricity we discussed the structure of the atom and how electrons travelled in orbits around the positively charged nucleus in a series of shells, each one with its own energy level. For an electron to leave its shell and move to a higher shell, energy had to be added to it (in the form of heat perhaps) while energy was released (heat or light) when the electron dropped back to a lower level. We said that the best conductors had only one electron in their outermost valence shell and that that electron was very mobile; it could move into the shell of another atom easily. When potential was applied to that conductive material, electrons would easily flow through it, skipping from one shell to the next as it travelled through the material. Materials in which the valence shell was completed by being filled with the required number of electrons (eight) became very stable, not easily permitting electrons to move. These materials are called non-conductors or insulators. Materials which have four electrons in their valence shell are called semiconductors and are the kind of materials used to create diodes, transistors and numerous other useful electronic devices.

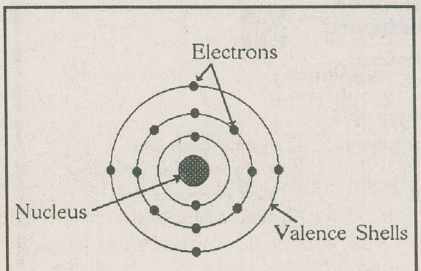


Figure 1A. A Silicon Atom

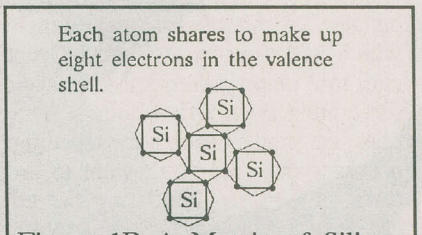


Figure 1B A Matrix of Silicon Atoms Sharing Electrons

Semiconductor materials, mostly silicon and to a lesser extent germanium, are not good conductors or insulators. Some electrons will flow through them but for the purposes of creating useful electronic devices they must be 'doped' with impurities which will selectively change their atomic structure so that they can be used. By introducing either trivalent or pentavalent materials such as aluminum, gallium or antimony (three or five electrons in the valence shell) during the manufacturing process, P-type or N-material can be formed. N-type material, with pentavalent doping, is a matrix of shared electrons similar to undoped semiconductor material except that because of the fifth electron contributed by the doping material, there are many free electrons, called majority carriers, available to move around in the material. P-type material, on the other hand has a deficiency of electrons. We can think of it as having an abundance of 'holes' (the spot in the matrix where there is an electron missing). In P-type material we call the holes the majority carrier. Minority carriers in N-type material are the holes while minority carriers in P-type material are electrons.

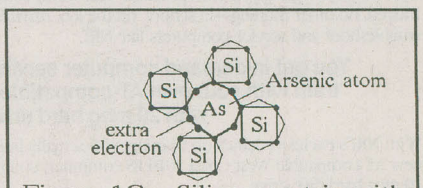


Figure 1C. Silicon matrix with doping

So what?

It turns out that if we put a piece of N-type material next to a piece of P-type material something interesting happens. At the junction of the two materials the extra electrons in the N-

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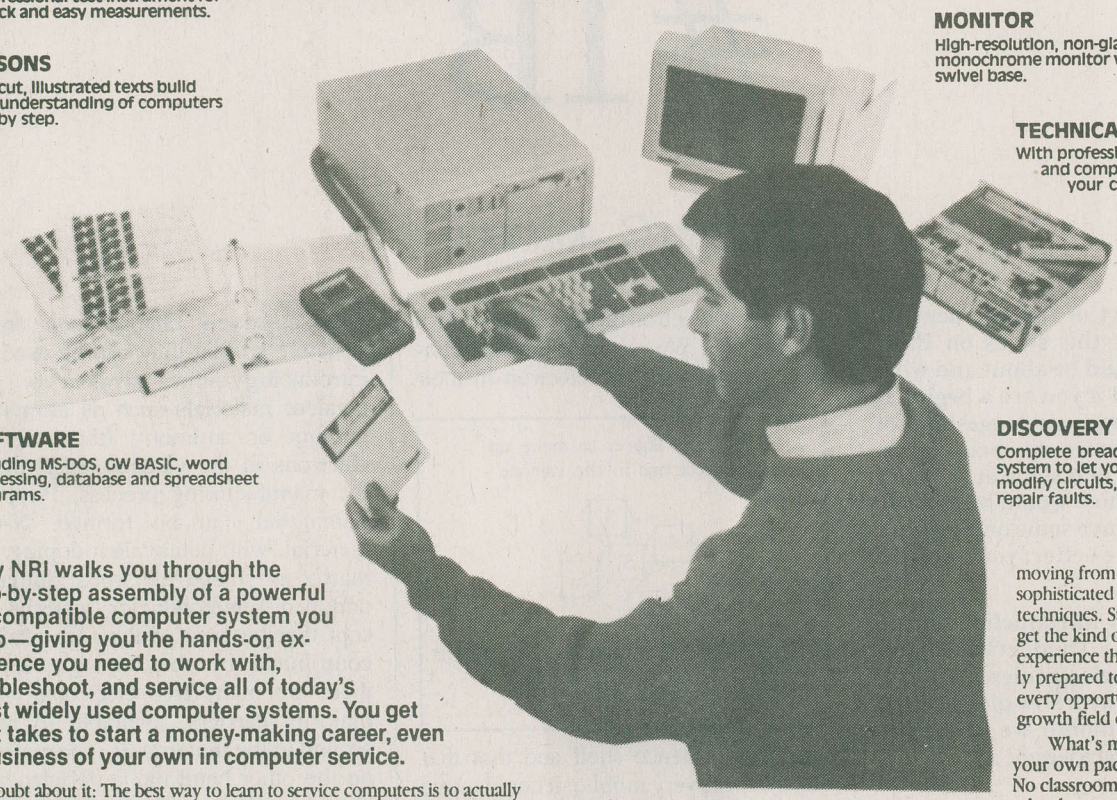

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Circle No. 90

Multi-Platform Publishing

Some Insights from the Canadian Marketing Manager of Ventura Software Inc.

Julius da Costa

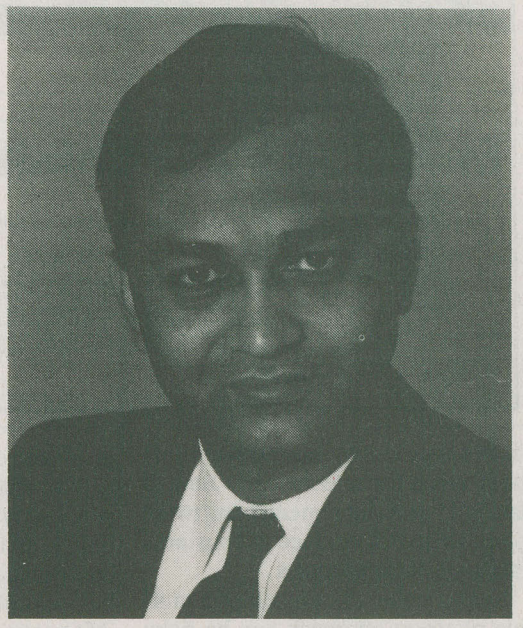
Every software vendor today must deal with the reality of multiple-platform corporate business computing environments. With hardware prices dropping and demand for computers growing throughout national companies, rigid source control by decentralized Information Systems organizations has yielded to ad hoc department-level purchasing decisions. The imperative is to give workers significant computing power at their desktops.

This freedom of choice, while liberating in many respects, has been balanced by a strong bottom-line motivation to realize maximum payback on existing computer resources. Thus LANS and inter-network schemes are becoming more and more important. Technology, to be useful, has to provide solutions that satisfy the customer's current needs; and businesses based on technology products must ensure that what they are buying today can be leveraged tomorrow.

"Battle of the Platforms"

Personal-computing pundits might have you believe that there is a winner-take-all battle going on for platform performance. In the area of PC software, for instance, the long-time DOS standard was challenged by OS/2 for a time, followed by a resurgence of interest in Windows. In dealing with this potentially volatile situation, it is important to sort out the motivation of users to adhere to their present platforms or move to new ones.

Dispensing with the mythology of "battles" and "either/or choices" is the first step. Just as no set of circumstances could suddenly enable Europe to reach full unification on January 1, 1992, users and vendors alike will not collectively accept one standard for all their desktop needs.



DOS, Windows, OS/2, and Macintosh will all have substantial corporate user bases for years to come. Simply stated: DOS was right and will continue to be right in the global PC market for some time, DOS/Windows and Macintosh are right, and OS/2-PM will be right.

In addition, workstation products from Sun, DEC, IBM and Hewlett Packard are important platforms. These products use cost-effective, high-performance RISC architectures, in conjunction with the standard UNIX operating system, to offer a sound new alternative when workgroup computing is included in decision criteria.

At present, many corporate decision-makers are wary of committing prematurely to a next-generation OS/2 standard. They see many users who are not seriously hampered by the 640K memory limit of DOS, and are content with their XT and early AT-level PCs. Windows has some appeal to these users as a low-risk upgrade that does not threaten the application software status quo.

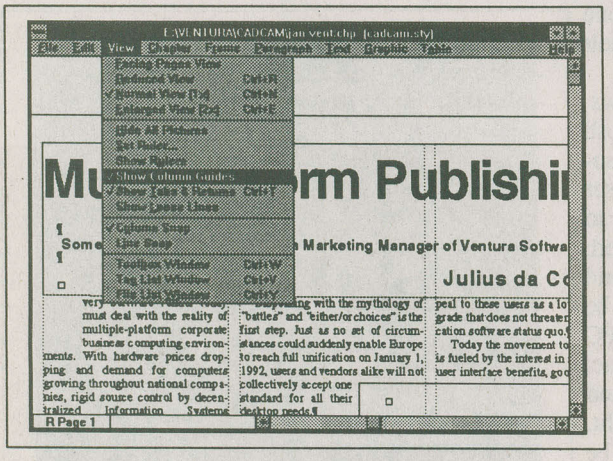
Today the movement to Windows is fueled by the interest in its graphic user interface benefits, good memory management capabilities, and by the semblance of multi-tasking it offers. Most PC users as yet have no clear idea of how the true multi-tasking capabilities of OS/2 and UNIX will benefit them. Many are quite satisfied, for now, with the concurrent access to multiple applications offered by Windows 3.O

There is a growing understanding among users of the value of multitasking and workgroup computing. Moreover, there is a growing certainty among industry experts that the

technical superiority of OS/2 and UNIX will make these environments the dominant desktop platforms for office automation and information/image management by the end of the decade. Microsoft is facilitating migration to OS/2-PM with its toolkit for moving Windows applications.

Challenges for developers

Satisfying customer needs in this multi-platform world poses considerable challenges to software companies. It is important to support the DOS community, which remains very large and in many cases includes the oldest and most loyal customers. Yet



it is not easy to continue adding functional value for a technically limited platform, and incremental software upgrades do not produce the business viability of new products.

Realistically, the pursuit of a multiple-platform approach can be risky for developers. If a new version of a product does not offer features common in the new environment, then the customer will more than likely be disappointed with the product. Therefore, the initial product development is critical to the success of the development of additional versions.

For instance, if a product was designed with the intention of development for additional platforms, and if it was written using the C language, the task of porting or transferring that product to a new environment is greatly simplified. Knowledge regarding the differences between the Intel and Motorola processors is also helpful when developing products for different environments. Also, if an application is written using common code, it is easier for technical support personnel to answer questions regarding different products, assuming they have fairly solid comfort level with the different environments.

Committing to a new platform typically means an investment of dozens to hundreds of R&D man-years. This means a vendor must accurately predict rate of acceptance in the market or suffer the consequences. For example, companies that decided three years ago to bypass Windows and concentrate on OS/2 development saw little initial return on investment, and they now find themselves scrambling to address the Windows market. Yet these newer platforms offer the greatest growth potential and any vendor who wishes to stay competitive must also eventually, support them.

The challenge facing vendors now is not only to support these platforms individually, but also to provide cross-platform products that serve the business objective of enterprise-wide information flow. In addition, vendors must anticipate that higher performance hardware and multi-tasking operating systems will demand more sophisticated workgroup-oriented application software.

We must also recognize that we compete in a global marketplace. Any large corporation is likely to do business in every part of the world. A vendor whose development does not consider international requirements will be at critical disadvantage in this world-wide marketplace.

Meeting the Challenge

There is no single, perfect solution for every user. Multiple platforms will prevail and desktop software suppliers must bring solutions to customers on the platforms of their choice.

At Ventura Software we are responding to these challenges with both current and long-term product strategies. By year-end 1990 we will have introduced the latest and most powerful desktop publishing software, Ventura Publisher Gold Series 3.O, in versions for DOS (GEM), Windows, OS/2 (PM) and the Macintosh. And in the second half of 1991, we expect to ship the same leading-edge desktop application on the Sun SPARCstation (OPEN LOOK).

Also in the Windows 3.O environment we offer FormBase, a powerful forms processor integrated with a fully relational database manager. FormBase supports Windows 3.0, and in 1991 and 1992 will be ported to the OS/2 and UNIX environments. These new versions affirm Ventura Software's commitment to developing software for today's corporate multi-platform environments.

The complementary strengths of Ventura Publisher and FormBase suggest many possibilities for adding value by using them, separately and together, to manage, integrate and persuasively present information. In addition, both are designed to serve the world marketplace. Several foreign-language versions of Ventura Publisher are already in use worldwide, and FormBase is also currently being translated into six languages.

The potential of these two highly innovative products will be developed as we move into the next decade. Ventura Software has accepted the mission of supporting our customers with leading products on their platforms of choice — today and in the future. And that is the only battle line we have drawn for the 1990s.

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Despite having added everything even remotely graphical to the software, Corel Draw remains basically easy to use and has a gentle learning curve. You can get started quickly by ignoring its advanced features and subsequently apply more and more of the software as you become familiar with it.

Corel Reefs

If you've used Corel Draw in the past to generate headlines and other typographical effects, you'll probably be impressed first with the program's newly expanded range of bundled typefaces. While it has always been possible to add just about any typeface you liked to Corel Draw, the package now comes with 150 fonts, every one of them matching an Adobe PostScript face perfectly. (Let us not speculate how they got that way.)

Aside from the basic typeface library that accompanied version one of Corel Draw, all the popular mutant faces are available now. Thrill to the sensuous lines of Böcklin, kick Helvetica into the scuppers with Eras, be spectral with Umbra and look European with VAG Rounded — to name but a few. The complete list is hereabouts. The names on the list are the real names of the fonts, rather than the pseudo-names that Corel Draw is shipped with for legal reasons. (In North America, so far, font *names* can be copyrighted, but fonts can't.)

In addition to merely providing one with more fonts, Corel Draw's WFN Boss font manager program has been expanded so as to allow you to edit and create fonts with Corel Draw.

Along with more fonts, Corel Draw now comes with about twice as much clip-art. It's now organized on the master disks by subject, rather than by company of origin. The range of images is impressive. Amidst the eighty or so pages of pictures in the accompanying clip-art catalog you'll find a picture of Saddam Hussein, a microwave oven, several fish, floppy disks, a shamrock, flags, uncle Sam... Sadly, there's no picture of Brian Mulroony in all that. One can think of a lot of uses for such an image.

Clip-art images are combined into library files, compressed using the well-accepted LHarc utility. The included Mosaic module allows you to preview and retrieve images from the libraries, and even to create libraries of your own.

Corel Draw also has a new "symbol" facility. This allows you to add individual characters from a symbol "font" to a drawing as easily-handled objects, rather than as strings of text.

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The symbol dialog lets you scan through the available symbols in a font to easily find the ones you want.

Symbols are stored as fonts; you can create your own symbol sets using WFN Boss. Three sets come with the package — Dingbats, Carta (a set of geographical symbols) and Sonata (which allows you to typeset music).

One of the most powerful of the text-related functions of Corel Draw 2.0 is its ability to deal with a lot more text at a time. In addition to the original text-entry function, which is still limited to a few hundred characters per text object, you can now deal with whole blocks of "paragraph" text. You can import text from disk files or through the clipboard and add multiple paragraph text objects to a drawing. All the fonts and type effects are available to apply to big text blocks.

While a bit cumbersome as a desktop-publishing package — it tends to bog down a bit when asked to deal with a whole page of nine-point type, for example — Corel Draw makes a first-class tool for laying out individual pages containing a mixture of text and graphics. It's great, for example, if you have a lot of advertisements to build.

Another interesting text facility of Corel Draw is the equivalent of mail merging. You can create a drawing with replaceable text fields in it and then merge in a text file to fill the fields. This would allow you, for example, to create a blank diploma and then have Corel Draw run off a few hundred of them, each with a different name filled in.

Extrusion

There are a number of new special effects available under Corel Draw that can generate stunning images. The most interesting of these allow you to meddle with the overall shape or "envelope" of an object to give it a distorted appearance.

Having selected an object, you can twist its envelope to change its overall shape. You bend the envelope containing the object into a trapezoid, giving the object perspective — either the one- or two-point variety. You can "blend" two objects, creating any number of intermediate objects between them. Finally, you can "extrude" an object, that is, you can make it appear to have depth, with or without perspective to it.

Corel Draw 2.0 includes quite a few new fill options. It has a vastly improved color selection system that lets you specify color either numerically or simply by clicking in a graduated color box. There's also a wider choice of color models to choose from. You can name the colors you create to help keep track of them.

Particularly praiseworthy is Corel Draw's excellent support for 256-color Windows displays. You can tell Corel Draw to use the 256 pure colors, or to dither all colors, or to use pure colors for some purposes and dither when necessary, or even to fiddle the 256-color palette — a bit of a no-no under Windows, but the only way to get the most from your video card.

Corel Draw now allows you to create your own fill patterns from tiled objects and from bitmapped fragments. This latter effect is extremely slick, as you can have it tile filled objects with bits of other images.

Another interesting feature of the latest Corel Draw is its ability to import color bitmap files. This means, for example, that you can import a PCX file and have Corel Draw do color separations for you. While its bitmap separations may not be the equal of what you can get from a separation house, they're pretty respectable. Corel's printing options — including color separation — are considerably extended over those of the previous version, and more than ample for all but the most fantastically demanding work.

The user interface of Corel Draw 2.0 is vastly improved. The status bar provides you with more information; there's a color palette at the bottom of the screen for quickly selecting fills; and moving objects around is more powerful than ever. Aside from just picking them up and pulling them to where you'd like them to be, Corel Draw now allows you to position them numerically. You can even nudge an object by a specific amount using the cursor keys; the nudge distance is, of course, adjustable.

The snap grid can now be made visible if you like, appearing as blue dots in the workspace. In addition, you can pull as many *guidelines* into the workspace as you like, in the same way PageMaker allows you to do.

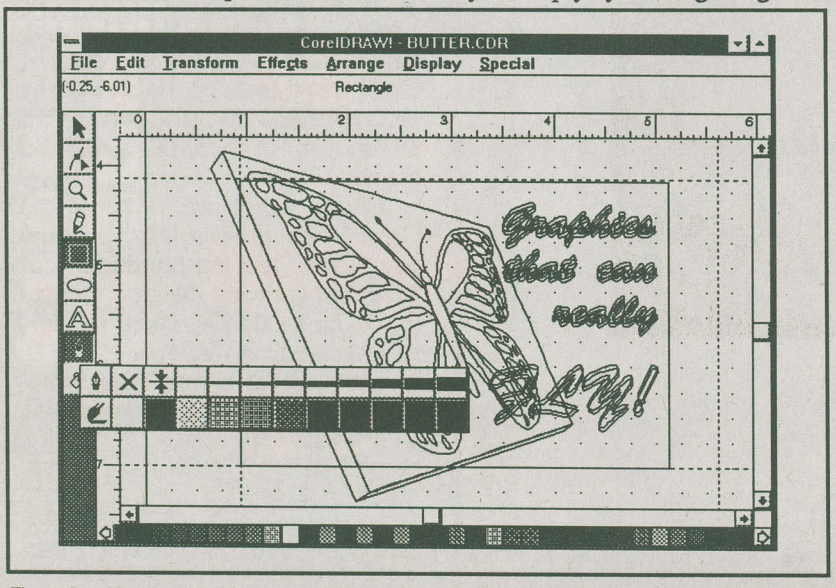

Fig. 1: Corel Draw makes it easy to set line widths and colors. Note wire-frame display.

These serve as alignment guides, and can be snapped to. (You can position them numerically as well.) Although the capability is unfortunately buried deep in the Preferences dialog, Corel Draw even allows you to switch to a crosshair cursor, the type preferred in technical-drawing applications. (Alas, there's no quick toggle for cursor modes.)

You'll find that most Corel Draw operations now have new Shift and Ctrl variants. For example, holding Ctrl while stretching an object forces the stretch to proceed in exact 100% increments; holding Shift makes the stretch symmetrical, extending both the side or corner you're dragging and the opposite one as well; holding both Shift and Ctrl, as you'd expect, combines the two constraints. Equally good news is that there are now keyboard equivalents for almost all major operations (in addition to the Alt-key options afforded by Windows).

The CDR file format that is native to Corel Draw has been enhanced a bit. It now contains a field for small thumbnail versions of the image in each file. Just click once on the name in the File..Open dialog box and the thumbnail will appear in a window. Corel Draw will still read CDR files from earlier version of the software; the thumbnails won't appear, of course. (Corel Draw can still Export files in the older format.)

Corel Draw no longer burdens your WIN.INI Windows configuration file with all its own font and filter information; instead, there's just a one-line pointer to the new CORELDRW.INI file that Corel now uses to store all this arcana. Other "hidden" features include: timed automatic file backup; the ability to automatically start Corel Draw with its window maximized to full-screen; true 3D-look buttons for Windows 3 compatibility; an animated hourglass cursor to stare at during lengthy operations; and, most important of all, a new balloon icon, in color.

The documentation looks much as it did before, despite a greatly expanded content. In addition to all the paper, the Corel Draw package includes a decent video tutorial, and a classy plastic typesize guide. Alas, there's still no on-line help.(The accessory programs Trace and WFN Boss both do have built-in help.)

Running Corel

Despite all its extra features, Corel Draw 2.0 isn't particularly difficult to use, nor appreciably slower than its predecessors. It requires more disk space — about 6.5 Mb, as opposed to the 2.5 that was formerly sufficient. The clip-art will tie up almost another 10 Mb, if you choose to put it on your hard drive.

The update price for Corel Draw 2.0 is $125.00 plus ten bucks to ship it if you have an earlier version. Corel has been dispensing the updates with commendable velocity; most of the users we've been in touch with had already received their upgrades only a couple of weeks after the product officially shipped.

While most of the other drawing packages available for the PC seem to have stalled in their development, Corel Draw looks to be continually getting better. This version is bug-free as far as we've been able to tell, and breathtaking in its scope.

Finally, of course, it's made in Canada. Being aware of this before you buy it, you can lay down your Visa card knowing that you're helping out the locals. This is considerably more noble than finding a "Made in Canada" sticker tucked away somewhere a week after you've brought the thing home.

DTP

Corel Draw 2.0: Corel Systems Corp, 1600 Carling Ave, Ottawa, ON K1Z 8R7; phone (613)728-8200; fax (613)728-9790.

QMS PS-2220

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The PS-2220 is a true Adobe PostScript 300 dot-per-inch laser printer featuring the standard 39 PostScript fonts. It's the top-of-the-line printer in the 2200 series. The PS-2210 is virtually the same, but offers only a single paper tray. HP LaserJet+ and HPGL (HP7475A) plotter-language emulation are built in.

In addition to Centronics parallel, RS-232C and RS-422 interfaces, the PS-2220 has built-in AppleTalk support. Baud rates up to 57,600 baud, XON/XOFF and DTR protocols are all supported. For those with more-demanding font requirements, the PS-2220 accepts an optional off-the-shelf SCSI 20 or 40 Mb hard drive. With this installed, fonts that once had to be downloaded can effectively become printer-resident.

Printing speed is rated as a rather fast 22 pages per minute. We were impressed with the speed at which the PS-2220 spit out fully-loaded 11x17" pages from Ventura 3.0 running under Windows 3.0. To achieve that timely output speed, the PS-2220 uses a 16.67 MHz Motorola-based internal controller, 4 Mb of RAM and 1 Mb of ROM. The printer can handle full-page graphics on a variety of paper sizes, including letter, legal, 11x17, half-letter, A3, A4, A5, A6, FLS A and FLS E sizes. The QMS PS-2220's engine produced crisp images with solid blacks.

Toner cartridge life is rated at 6000 pages at 5 percent coverage, while the drum is rated to last 12,000 prints. The recommended duty cycle is 20,000 pages per month. Changing the toner and drum cartridges is done easily through a door on the front of the printer.

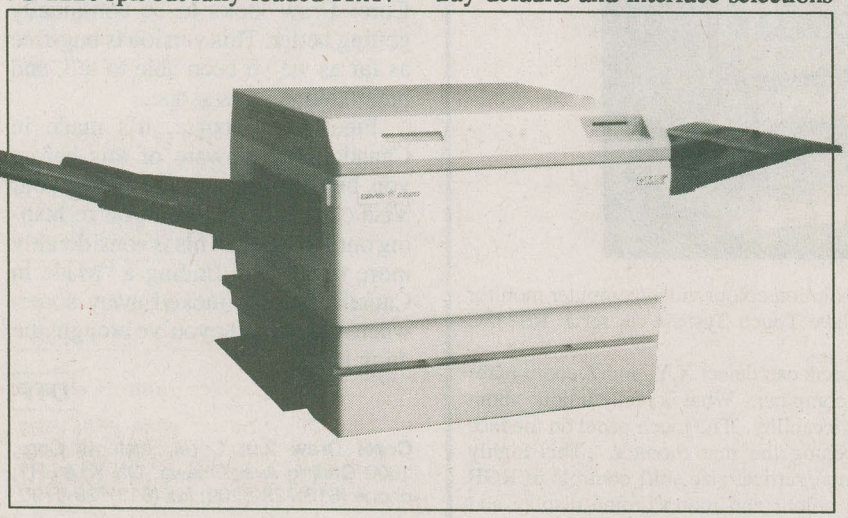
The PS-2220 offers a remarkably user-friendly two-line LCD display for controlling the printer's various internal functions. We found ourselves switching emulations, paper-tray defaults and interface selections without even consulting the documentation.

The two removable 250-sheet paper trays are virtually concealed within the printer body. The 100-sheet bypass feed tray and output hopper still hang off the unit's sides, but they tend not to get in the way of equipment on nearby tables and desks. The only minor drawback is the lack of a straight-through paper path from the trays. You can feed straight through, however, by using the manual bypass tray.

Our demo unit came with some very interesting utility software. The Executive PS Series of IBM PC and Macintosh utilities for PostScript printers includes: a menu-driven setup program; an intelligent typeface downloader that won't overload the printer; memory-resident PostScript print screen; software emulation switching; printer hard disk utilities; and more. Macintosh software includes: additional screen fonts; a desk accessory for dual-tray printers; PostScript file downloader; and a Namer for renaming network printers.

The price of the PS-2220 is currently far less than what you could expect to pay for many other printers capable of printing on 11x17" paper. What you get for your money, though, is considerably more. For power users, especially those doing a lot of graphics, desktop publishing and CAD work, the PS-2220 is worth a long, hard look.

DTP



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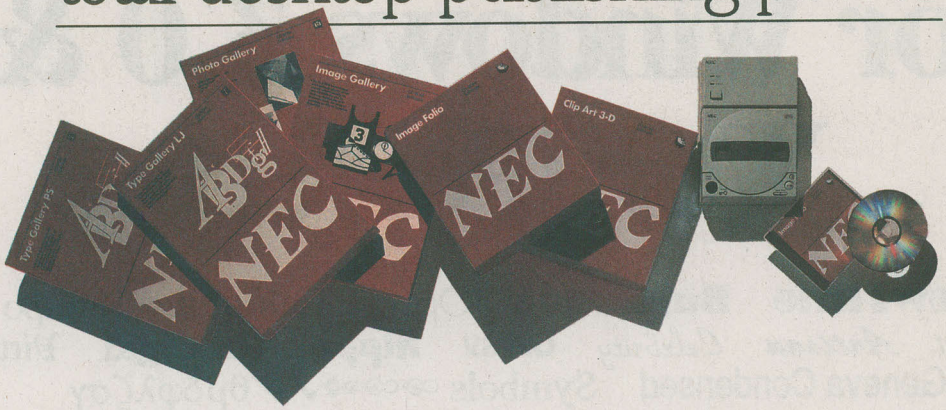

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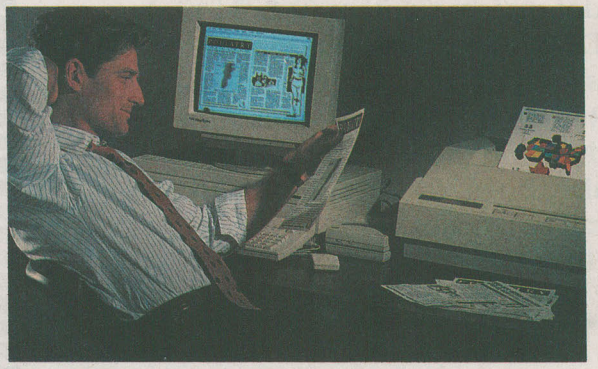

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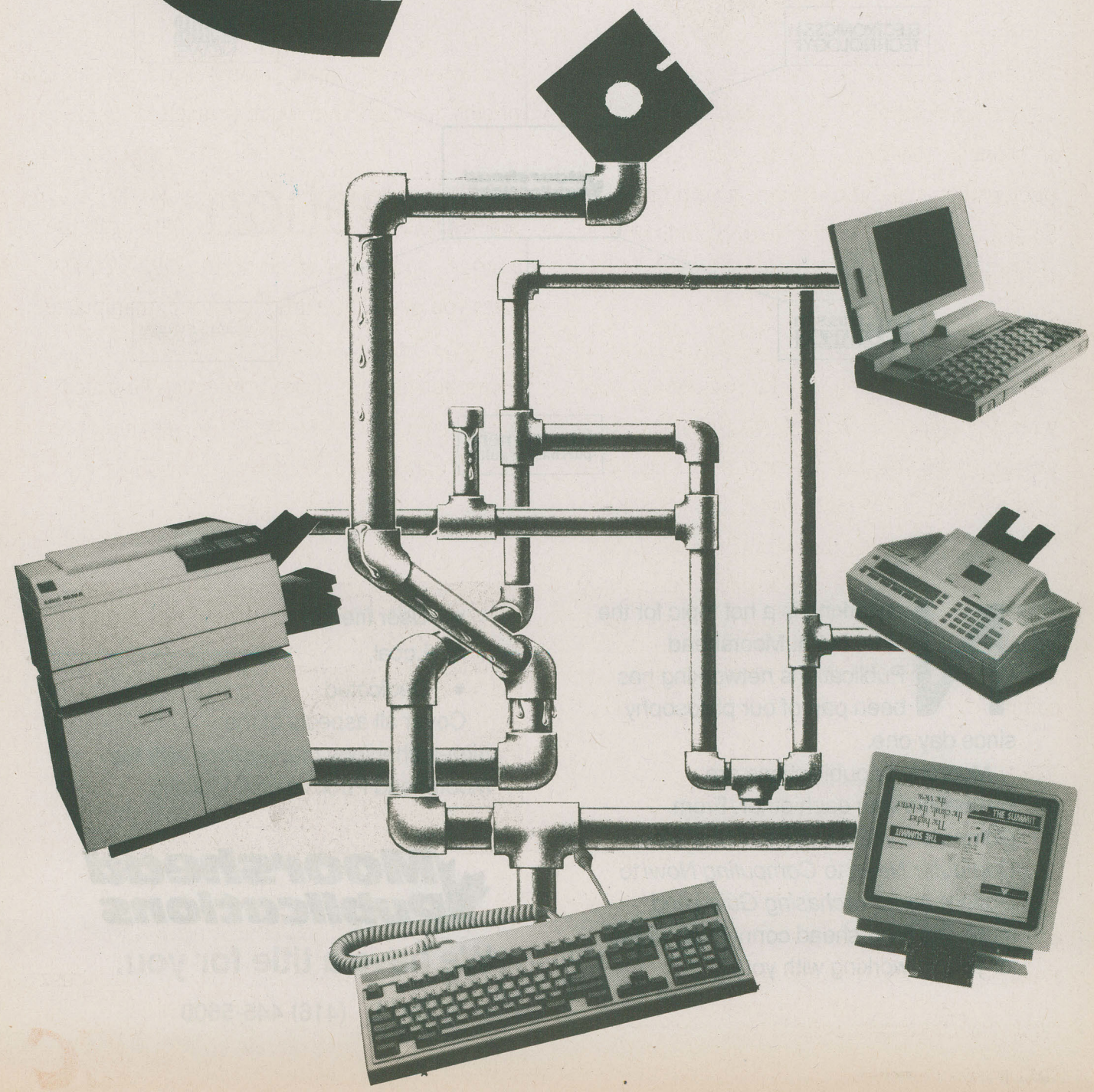

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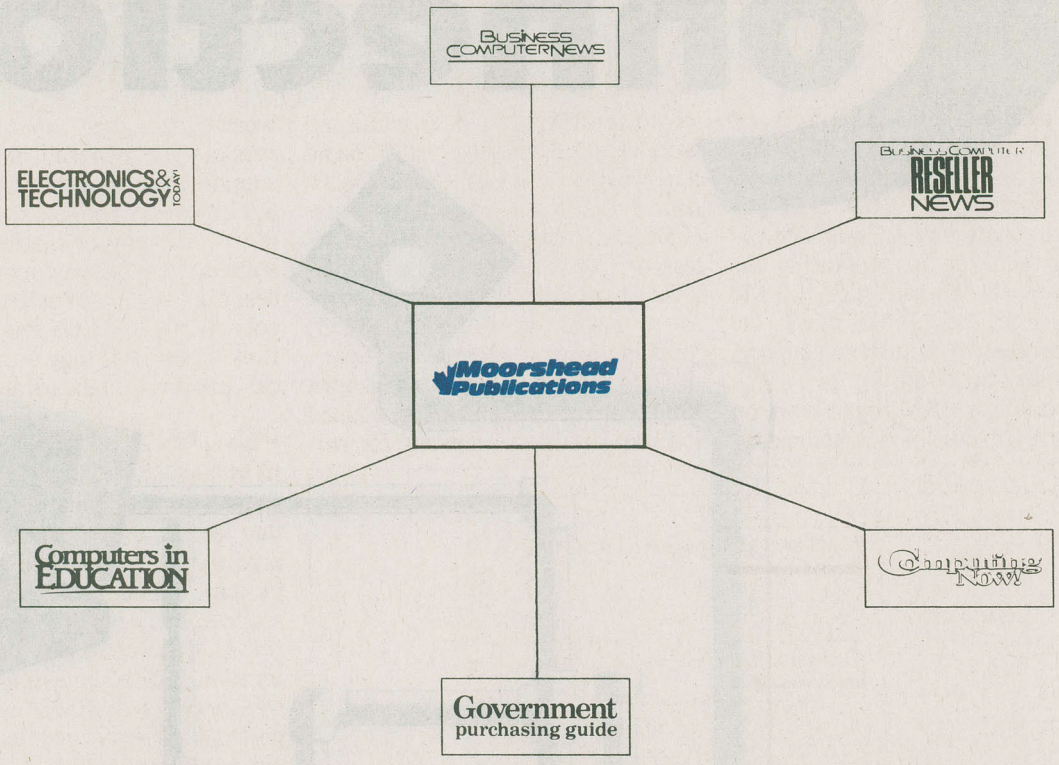

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History of LAN Manager

Reprinted from "LAN Manager, A Programmer's Guide", from Microsoft Press

Ralph Ryan

In 1983 and 1984, Microsoft and IBM were designing DOS version 3.0 to support the soon-to-be-announced IBM PC/AT personal computer. It was decided that, in addition to supporting the AT's new 20 Mb hard disk, 1.2 Mb floppy disk, and CMOS clock, the new operating system should support local area networking.

Accordingly, IBM began work on the IBM PC Network Adapter and released specifications for essential network support using the NetBIOS and the Network Control Block (NCB) data structures for machine-to-machine communication. IBM also released specifications for a higher-level (more abstract) protocol known as the Server Message Block (SMB) for client-to-server communication.

DOS version 3.0, released in April 1984 with the IBM PC/AT, contained some of the basic elements for networking personal computers. DOS version 3.1, released in July 1984, supplied the remaining pieces. DOS 3.1 contained support for a *redirector* — a piece of operating-system software that allowed remote-file access. The redirector used SMB protocols and the NetBIOS to make remote files appear as if they were on a logical disk drive on the local computer.

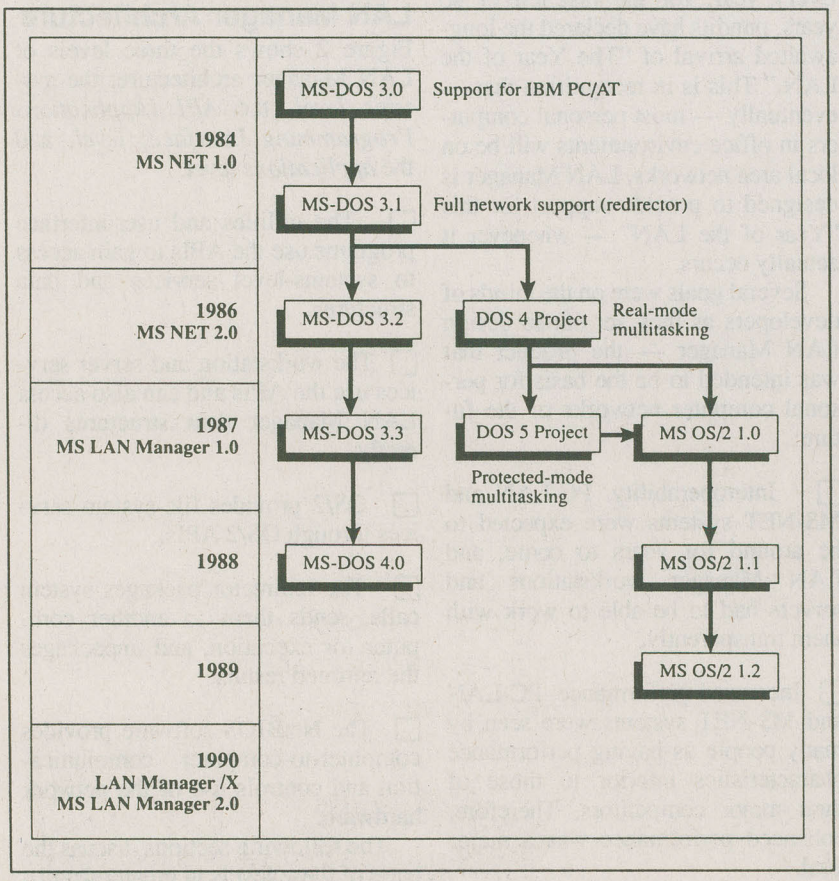


Fig. 1: The history of MS LAN Manager.

PC-LAN and MS-NET

IBM took the redirector and added some workstation and server software that made files and printers available across the network. The result was a product called the *Personal Computer Local Area Network Program* (PC-LAN). Microsoft then released its own version, known as *Microsoft Networks* (MS-NET), which supported third-party personal computers and network cards.

The two products were similar and interoperable: MS-NET workstations could use resources shared by PC-LAN servers and vice versa. They differed in that PC-LAN supported interstation messages (not supported by MS-NET) and nondedicated servers; that is, a computer operating as a PC-LAN server could also be an ordinary workstation. The MS-NET server was dedicated: It could not be used simultaneously as a workstation.

Following the release of DOS version 3.1, Microsoft began — on its own — to develop a multitasking, protected-mode operating system for the Intel 80286 microprocessor. The protected mode of the 80286 microprocessor provided hardware protection that prevented programs from in-

terfering with each other or with the operating system. This was in contrast to the real mode of the 80286, which ran like a fast 8086 microprocessor and allowed programs full access to all memory, including the memory containing the operating system. The protected mode also allowed access to 16 Mb of memory; real mode limited access to 640K.

When this project began to grow in scope, it was split into two projects.

The DOS 4 Project

DOS 4 (not to be confused with the 1988 product of the same name) was a real-mode, multitasking operating system. IBM chose not to license DOS 4. Although it decided not to release DOS 4 as a retail product, Microsoft did make deliveries to several of its large customers for special applications under development.

Part of the DOS 4 operating system was a network upgrade known as MS-NET 2.O, which provided support for interstation messaging and a non-dedicated server. This upgrade made MS-NET 2.O and PC-LAN functionally the same.

The DOS 5 project

The second project, called DOS 5, eventually became the OS/2 operating system. It was a full multitasking protected-mode operating system. OS/2 was jointly developed by Microsoft and IBM. Part of the OS/2 development at Microsoft involved the creation of an OS/2 redirector. Development of both the OS/2 redirector and LAN Manager were well under way before IBM decided to license this additional technology and incorporate it into its OS/2 Extended Edition.

In September 1988, the first version of LAN Manager was shipped to 3Com, which had helped Microsoft design and develop LAN Manager. The resulting 3Com product, *3+Open*, incorporated the core LAN Manager and included DOS LAN Manager, an upgrade to MS-NET that allowed DOS workstations to use the power of LAN Manager servers.

In October 1988, IBM released the first version of its OS/2 Extended Edition, which contained the OS/2 redirector (or "requester," as IBM called it). The IBM LAN Server was a companion product built from the LAN Manager server technology.

In January 1990, Microsoft announced the LAN Manager/X product, a portable version of LAN Manager for UNIX, developed jointly by Hewlett-Packard and Microsoft. The LAN Manager/X interfaces were adopted by X/OPEN (a consortium of UNIX manufacturers) as the portable networking interface for UNIX.

Figure 1 provides a visual history and shows the relationships among the different versions of DOS. OS/2. and LAN Manager.

The LAN Manager Project

Every year. for the last ten or so years, pundits have declared the long-awaited arrival of "The Year of the LAN." This is in recognition that — eventually — most personal computers in office environments will be on local area networks. LAN Manager is designed to provide support for this "Year of the LAN" — whenever it actually occurs.

Several goals were on the minds of developers as they set out to design LAN Manager — the product that was intended to be the basis for personal computer networks of the future:

☐ Interoperability. PC-LAN and MS-NET systems were expected to be around for years to come, and LAN Manager workstations and servers had to be able to work with them transparently.

☐ Increased performance. PC-LAN and MS-NET systems were seen by many people as having performance characteristics inferior to those of their major competitors. Therefore, enhanced performance was a major goal.

☐ Full-featured administrative support. The skills of network administrators vary widely, but a good LAN product would make it easy for all administrators to do their jobs well. Of particular importance was the ability to remotely administer servers.

☐ Distributed-applications platform. The proliferation of personal computers on LANs required a change in how applications work. Applications would have to be spread out into cooperating programs on more than one computer, and the LAN software would have to make it easy for developers to create these applications.

☐ A rich applications programming interface. Programmers needed to be able to create applications that added value to the core product.

LAN Manager Architecture

Figure 2 shows the three levels of LAN Manager architecture: the *systems level*, the *API (Applications Programming Interface) level*, and the *applications level*.

☐ The utilities and user-interface programs use the APIs to gain access to systems-level services and data structures.

☐ The workstation and server services use the APIs and can also access LAN Manager data structures directly.

☐ OS/2 provides file-system services through OS/2 APIs.

☐ The redirector packages system calls, sends them to another computer for execution, and unpackages the returned results.

☐ The NetBIOS software provides computer-to-computer communication and controls use of the network hardware.

The following sections discuss the parts of these levels in greater detail.

The NetBIOS

Under DOS, all hardware-specific software is grouped into a set of interfaces known as the *BIOS* (Basic Input/Output System). So when DOS is ported to different hardware, the BIOS is the only part that requires change.

the NetBIOS provides a regular interface and independence from network hardware — just as the BIOS does for computer hardware-and at the same time. it provides a set of commands for establishing and controlling network communications between computers. LAN Manager uses the NetBIOS as a device driver to handle all low-level details of network communications.

What Does the NetBIOS Do?

The NetBIOS has three main functions: It registers unique names on the local area network. it establishes virtual circuits, and it supports datagram communication.

Each computer on the network has a unique name built into the network hardware. This is the permanent node name, a 48-bit number provided by the manufacturer. But because 48-bit numbers don't lend themselves to easy memorization, the NetBIOS lets you register one or more unique names for each machine on the network and then use the name(s) when you establish communications:

☐ The first name registered is the *computer name*, a synonym for the permanent node name.

☐ The second name is the *username*, which distinguishes the person using the computer from the computer name.

☐ Additional names (called *alias names*) can be added through the Net-BIOS, as you'll see in the discussion of the LAN Manager Messenger service.

The NetBIOS also accepts a special kind of name shared by multiple workstations. Such *group names* allow all workstations with the same group name to receive data at the same time.

Virtual Circuits

Another main function of the NetBIOS is the establishment and maintenance of a *virtual circuit* between two names. A virtual circuit is a point-to-point reliable duplex connection: that is. once a virtual circuit is established, it handles all routing problems between the two ends and handles any necessary retransmissions to ensure successful data transmission.

Although the two names will usually be on different computers on the network, you can create a virtual circuit between two names on the same computer or even from one name back to itself (a loopback).

In addition to virtual-circuit communication, the NetBIOS also supports *datagram communication*. A datagram is a one-way message; that is, its arrival is not confirmed. A good analogy is that datagrams are like letters sent through regular postal channels: delivery is not ensured. Virtual circuits are like letters mailed with "return receipt requested": Delivery is always confirmed. Datagram communication is faster than virtual circuits, but it is less reliable.

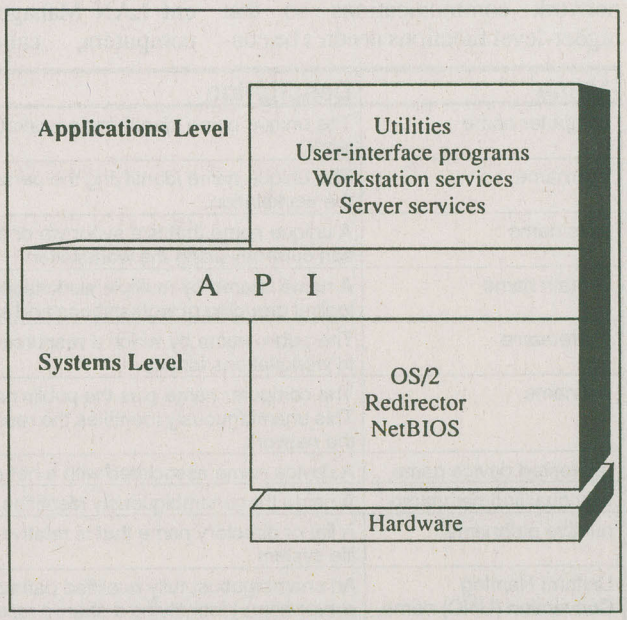


Fig. 2: LAN Manager: An architectural view.

NetBIOS Operation

As described earlier, the main functions of the NetBIOS are to establish a virtual circuit and to allow data to be transferred reliably between two computers. The basic data structure in the NetBIOS interface is an NCB (Network Control Block). NCBs are submitted to the NetBIOS using the NetBIOS APIs.

The following discussion examines some of these NCB types (ADDNAME, LISTEN, CALL, RECEIVE, and SEND) and describes their role in establishing computer-to-computer communication.

After unique names are associated with each computer (ADDNAME NCB), the server indicates its willingness to establish a virtual circuit (LISTEN NCB). Then a workstation can initiate communication with a server by requesting a virtual circuit to a specific name (CALL NCB). Each computer's NetBIOS drivers exchange the necessary messages to set up the virtual circuit. The server indicates its willingness to receive data on a specific virtual circuit (RECEIVE NCB). The workstation then issues a SEND NCB that the NetBIOS matches up with the corresponding RECEIVE at the server. Figure 4 documents this process.

Note that you can send a message on a virtual circuit only after the server submits a RECEIVE NCB. The contents of a SEND/RECEIVE are arbitrary: they simply allow a block of data to get from here to there. Higher-

level protocols are used to structure the contents of the SEND/RECEIVE data.

NOTE: A NetBIOS can use one of several internal protocols to communicate to another NetBIOS: NETBEUI, XNS, TCP/IP, or OSI. But no matter which protocols are used inside the NetBIOS, the interface remains the same: NCBs are passed to the NetBIOS driver through the NetBIOS APIs.

Communications protocols let you structure the functions required by network communications so that higher-level functions needn't be concerned with the details of lower-level functions. This use of levels of abstractions is the same principle you would use in good software design where an API provides services to system functions: the applications need know only the interface specifications and the functional description; the details of implementation are left to the lower layers.

ing for data with a RECEIVE. The other side is active., initiating the virtual circuit with a CALL NCB or initiating a transaction with a SEND NCB.

The passive side is called a *server*; and the active side is called a *client*. This model is used throughout the LAN Manager architecture: applications, API calls, and systems services all have client and server sides. The concept is generalized so that some computers, called *servers*, mainly handle the server side of these different LAN Manager functions. Other computers, called *workstations*, mainly handle the client side of LAN Manager functions.

Name	Description
computer name	The unique name identifying a workstation on the network.
username	The unique name identifying the person currently using the workstation.
alias name	A unique name that is a synonym or an alias for the person currently using the workstation.
domain name	A name shared by multiple workstations, identifying a logical grouping of workstations and servers.
share name	The public name by which a resource is made available to workstations for use.
net name	The computer name plus the public name for a resource. This unambiguously identifies the resource for the rest of the network.
redirected device name	A device name associated with a net name.
fully qualified pathname	A name that unambiguously identifies a file or directory.
relative pathname	A file or directory name that is relative to a location in the file system.
Uniform Naming Convention (UNC) name	An unambiguous, fully qualified pathname (including server name) identifying a shared resource. Lets a workstation use a server resource directly without explicitly connecting first.

Table 1: Names used by LAN Manager.

The Client-Server Model

Notice that in the model of NetBIOS communications, one side is always passive, waiting for a virtual circuit with a LISTEN NCB and then waiting for data with a RECEIVE. The other side is active., initiating the virtual circuit with a CALL NCB or initiating a transaction with a SEND NCB.

Client and server are logical concepts: they can exist on the same physical computer. A LAN Manager server can also be a client, either of itself or of another server. Synonyms for client are workstation, redirector, requester, and consumer.

A server. which is usually more powerful than a workstation, contains resources — such as disks, printers, or serial-communications devices — that can be used by the clients.

An alternative to the Client-Server model is the Peer-to-Peer model, in which any computer can initiate transactions with any other computer.

In the Client-Server model, the server resources must be "shared" by the server before they can be used by clients. A share associates a specific resource with a publicly known name; clients then use this name to access the resource. An administrator is usually responsible for creating a share.

To use a shared resource, you associate a local device name (a drive name such as X: or a device name such as LPT7 or COM4) with the public "share" name. For example, at a server named "toolbox," an administrator might issue a command such as:

```
net share
tools=c:\progs\tools .
```

This shares the specified directory under the public name "tools." At a workstation a user can then issue the following command:

```
net use x: \\toolbox\tools
```

This associates virtual drive X: on the workstation with the shared resource \tools on the \\toolbox server.

Some advantages of the Client-Server model:

☐ Providing access to shared resources requires additional memory and processing power (as well as the resources themselves), so the Client-Server model allows a large number of less powerful machines to work with a small number of more powerful ones.

☐ The Client-Server model allows security to be centralized at the servers. In a Peer-to-Peer model, security processing must be distributed across all machines.

As the average workstation becomes more powerful, LAN Manager will evolve in the direction of the Peer-to-Peer model and will support a model of distributed security.

LAN

For more detailed information, you can do no better than the *LAN Manager Programmer's Guide*, from Microsoft Press. Check it out at your local bookstore.

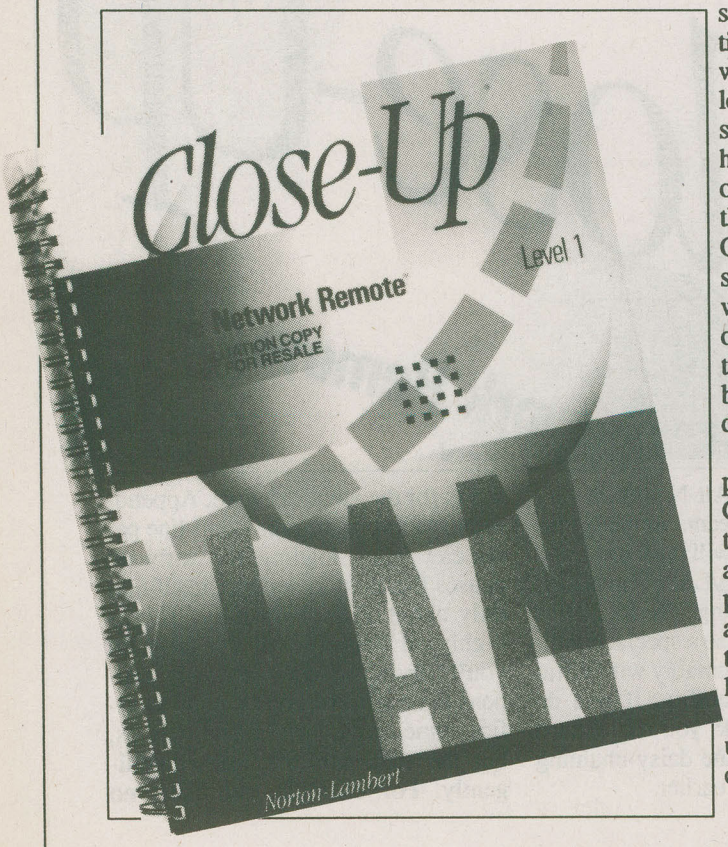
Close-Up LAN 2.0

The Clever Way to Be in Two Places at One Time

Frank Lenk

Operating a network takes more than just network software. Just as MS-DOS has become a comfortable place to live by virtue of the many little utility programs that populate it, so too the LAN can become a less forbidding environment, provided one enters it armed with a few choice bits of high-tech weaponry.

Close-Up/LAN, from Norton-Lambert, is a perfect example — a unique network tool, a program that can solve many a sticky network problem.



The Close-Up system actually consists of several different products, each supplying different capabilities. The ultimate aim is to place remote workstations in closer communication with each other than they have ever known before.

Close-Up/LAN, specifically, is a utility that allows two workstations on a network to act as one. Rather than merely sharing files, the two share their screen display output and keyboard intput. Using Close-Up/LAN, a support person can monitor or even take over a remote user's terminal. Obviously, this can be a real time-saver for applications such as software support, allowing support staff to "make house calls" without moving from their own desks. One can also envision multiple users working together on a project, even though separated by considerable distances.

A related pair of programs — Close-Up Customer/Terminal and Close-Up Support/ACS — manage much the same trick over a modem link.

For our tests, we used a very large corporate network, running IBM's own networking software across a variety of PS/2 workstations — most of them 80386-based. Close-Up/LAN worked flawlessly in this environment — even when connecting workstations physically separated by several floors, and electronically separated by several LAN bridges.

Matched Set

According to the documentation, Close-Up/LAN works with any NetBIOS or Novell IPX network — which should cover just about anything.

Installation is no big deal. In fact, the software will automaticallly detect the type of network you're using, and configure itself to suit.

Close-Up/LAN actually includes two matched pieces of software: the Viewer and the Host. Typically, you install these on two separate workstations — although there's no reason you can't load up both on one system. Both programs run as TSRs, resident in memory. Pressing the Alt-V or Alt-H hotkey pops up the Viewer or Host menus, respectively. With the Viewer loaded, you can also use the Alt-T hotkey to toggle between the remote session and your own local environment.

Using the simple pull-down menus, you use the Viewer to log onto the Host — any Host that's on the network and ready for business. You can select from all available Hosts by name. By default, Host workstations respond to the name under which they are logged onto the network; users can also specify a different name when

loading the Host software. Either side can initiate the connection; Hosts can specify password protection for themselves to keep out unwanted visitors.

Once the connection is established, the Host computer works normally in every way. The Host user can run application software, and generally carry on working as before. However, everything that happens on the Host screen is perfectly mirrored on the Viewer screen. Conversely, commands entered on the Viewer keyboard are recognized by applications running on the Host. To prevent confusion, it is possible to disable the Host keyboard. It is also possible to disable the Host's *screen*, should there be a need to perform actions that are best kept from tender eyes.

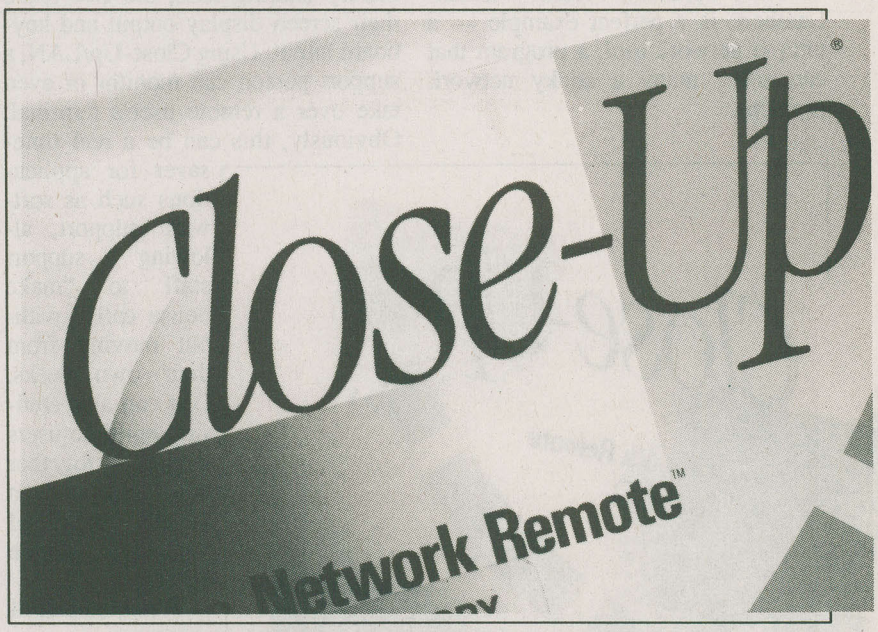
There is, of course, a marked delay in updating the Viewer screen. In most cases this is not a problem. It's most noticeable when scrolling text up the screen in DOS; for example, a long *dir* listing tends to flash up on the Viewer in spurts, rendering it rather less than legible. It's usually possible to work around the delay — for example, by using *dir /p* to force the directory listing to pause after each screenfull rather than scrolling uncontrollably.

Most applications show up much better than this worst case. It's not hard for a touch-typist on the Viewer end to outrace a word processor's character display, but the lag is never really so severe as to be confusing. One could get a lot of work done on a remote Host, in a pinch.

There's even a pop-up "dialog window", in which the Viewer and Host users can type comments back and forth to each other — much like the "chat" mode of a BBS (electronic bulletin-board system).

You can get arbitrarily fancy with your Host-Viewer connections. For example, it is possible to load up both the Host and Viewer on a single system. A remote Viewer could then connect to the Host software, and use the Viewer software to watch a third system running the Host. (In Close-Up parlance, this is known as daisy-chaining.) You can also combine the function of both Close-Up and Close-Up/LAN: phone a modem-equipped LAN workstation using Close-Up, then log onto a Close-Up/LAN Host elsewhere on the network.

Close-Up/LAN does have a built-in restriction on the total number of users. (Our program diskette was labeled as an 8-user evaluation configuration.) The limit refers to the total number of Viewers that can be simultaneously connected to a single Host, as well as to the total number of Hosts that can be simultaneously monitored by a single Viewer. In our case, for example, up to 8 Viewer users could crowd around a single Host system; a single Viewer could log onto 8 separate Host systems, allowing the Viewer user to toggle between the 8 sessions using the Alt-N hotkey.



In practice, it seems unlikely that many applications will push this limit. However, Close-Up/LAN is available in versions supporting 2, 8, 16, 32 and 64 users. There's also a special site-license version, presumably with virtually unlimited capability. If you do happen to get stuck, you can exceed the rated limit by the daisy-chaining procedure describe earlier.

Tiny Models

One area in which Close-Up/LAN does *not* excel is graphics, supporting only CGA mode. We had a tough time finding a piece of software anywhere on the massive corporate network that could actually be *run* in CGA mode; finally, we managed to temporarily reconfigure a copy of Lotus Manuscript. Manuscript has a very good graphic page preview mode. Once set up, this worked very well under Close-Up/LAN. We were unable to disturb the connection at all; the remote Viewer system remained a perfect mirror of the original. Of course, display updating was predictably slow. The Viewer display took

Our version of the package (version 2.5), included a special "tiny" mode for the Host software. Appending the appropriate command-line parameter when loading the software causes the Host to squeeze itself into only about 11K of memory. This is highly advantageous if the program you're trying to view remotely happens to be a RAM-hog. You do sacrifice some of the usual menu options, but the trade-offs are made intelligently. For example, the Host no

longer has the option of denying a Viewer call; by way of compensation, password log-on protection is automatically invoked.

To save even more memory, Close-Up/LAN 2.5 also adds a special "Extract" option. This takes a snapshot of the Viewer and Host EXE files as they exist when loaded in memory — at which point they won't include program code that handles functions that the user has specifically disabled. The snapshot can thus be much smaller than the original EXE version. According to the docs (we didn't have a chance to try this), the smaller versions can be run in upper memory above 640K, provided you have installed a 386 memory manager such as QuarterDeck's QEMM or Qualitas' 386^{Max}.

In summary, Close-Up/LAN is a very slick product indeed. It performs rather a tricky function without seeming to break a sweat. Virtually every conceivable option is built in. The only thing lacking is support for more modern graphic display standards — like VGA, for instance. But in text-mode operation, Close-Up/LAN leaves very little to be desired.

This could be just the trouble-shooting tool you're looking for.

LAN

Close-Up/LAN: Norton-Lambert Corp, P.O. Box 4085, Santa Barbara, CA 93140; phone (805)964-6767. Distributed in Canada by Keating Technologies Inc, 505 Hood Rd, Unit 22, Markham, ON L3R 5V6; phone (416)479-0230; fax (416)479-0232.

Close-Up LAN

BABANI BOOKS

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BP 265: MORE ADVANCED USES OF THE MULTIMETER *$11.80*
This book is primarily intended as a follow-up to BP239, and also should be of value to anyone who already understands the basics of voltage testing and simple component testing.

BP 261: A CONCISE INTRODUCTION TO LOTUS 1-2-3 *$11.80*
If you are a PC user and want to get to grips with lotus 1-2-3, then this book will teach you how to do just that in the shortest and most effective way.

BP 248: TEST EQUIPMENT CONSTRUCTION *$11.80*
This book describes in detail how to construct some simple and inexpensive, but extremely useful, pieces of test equipment.

BP 245: DIGITAL AUDIO PROJECTS *$11.80*
This book takes a look at the basic principles involved in converting an audio signal into digital form and then converting it back to an analogue signal again. It also contains practical circuits for constructors to build and experiment with.

BP 251: COMPUTER HOBBYISTS HANDBOOK *$23.80*
This book provides a range of useful reference material in a single source so that it can be quickly and easily located. The subjects covered include microprocessors and their register sets; interfacing serial, parallel, monitor, games and Midi ports; numbering systems; Midi codes; operating systems and computer graphics.

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This book is for the multitasking PC user that wants to get the most out of their computer in efficiency and productivity.

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BP239: GETTING THE MOST FROM YOUR MULTIMETER *$9.00*
This book is aimed at beginners and those of limited experience of electronics. Using the simple component and circuit testing techniques in this book the reader should be able to confidently tackle servicing of most electronic projects.

BP53: PRACTICAL ELECTRONIC CALCULATIONS AND FORMULAE *$11.75*
A book that bridges the gap between complicated technical theory and the "cut and try" method. A good reference book.

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Complementing Book PB74, "Electronic Music Projects", BP174 provides projects, such as a flanger, a phaser, mini-chorus and ring modulators, percussion synths, etc. Each project has an Introduction circuit diagram and constructional notes.

BP113: 30 SOLDERLESS BREADBOARD PROJECTS - BOOK 2 *$9.00*
R.A. Penfold
A companion to BP107. Describes a variety of projects that can be built on plug-in breadboards using CMOS logic IC's. Each project contains a schematics, parts list and operational notes.

BP150: AN INTRO TO PROGRAMMING THE SINCLAIR QL *$7.80*
Helps the reader make the best use of the Sinclair QL's almost unlimited range of features. Complements the manufacturer's handbook.

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In this book, R.A. Penfold has designed and developed several modern solid state short wave receiver circuits that will give a fairly high level of performance, despite the fact that they use only relatively few and inexpensive components.

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The Amstrad PC is an MS- DOS computer for general and business use. This book explains all you need to know to start computing.

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In this book, the newcomer to electronics will find a wide range of easily made projects. Also, there are a considerable number of actual components and wiring layouts, to aid the beginner.

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This book is intended as a beginner's guide to the Commodore 64.

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Intended to carry on from Book 1, this book deals with practical applications beyond the parallel and serial interface. "Real world" interfacing such as sound and speech generators, temperature, optical sensors, and motor controls are discussed using practical circuit descriptions.

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This book sets out to show how Electronic Music can be made at home with the simplest and most inexpensive equipment.

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R.A. Penfold
Although one of the more recent branches of amateur electronics, electronic music has now become extremely popular. The purpose of this book is to provide the constructor with a number of practical circuits for the less complex items of electronic music equipment, including such things as a Fuxx Box, Waa-Waa Pedal, Sustain Unit, Reverberation and Phaser Units, Tremelo Generator, etc.

BP110: HOW TO GET YOUR ELECTRONIC PROJECTS WORKING *$7.80*
R.A. Penfold
We have all built circuits from magazines and books only to find that they did not work correctly, or at all, when first switched on. This book will help the reader overcome these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.

BP86: AN INTRODUCTION TO BASIC PROGRAMMING TECHNIQUES *$5.85*
This book is based on the author's own experience in learning BASIC and also in helping others, mostly beginners to programming, to understand the language.

BP234: TRANSISTOR SELECTOR GUIDE *$15.00*
Listings of British, European and eastern transistor characteristics make it easy to find replacements by part number or by specifications. Devices are also grouped by voltage, current, power, etc., includes surface-mount conversions.

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A single source of easily located information: colour codes, pinouts, basic circuits, symbols, etc.

BP101: HOW TO IDENTIFY UNMARKED IC's *$1.95*
An unusual and fascinating chart that is highly recommended to all those interested in electronics and which will hopefully pay for itself many times over, by enabling the rEader to use IC's that might otherwise have been scrapped.

BP121: HOW TO DESIGN AND MAKE YOUR OWN PCBs *$5.85*
The purpose of this book is to familiarize the reader with both simple and more sophisticated methods of producing printed circuit boards. The book emphasizes the practical aspects of printed circuit board designs and construction.

BP125: 25 SIMPLE AMATEUR BAND AERIALS *$5.85*
This book describes how to build 25 amateur band aerials. The designs start with the simple dipole and proceed to beam, triangle and even a mini-rhombic.

BP180: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF MODEL RAILWAYS *$9.00*
Shows how home computers can easily be applied to the control of model railroads and other quite sophisticated control. A variety of projects are discussed as well as circuits for train position sensing, signal and electric points control, etc.

BP100: AN INTRODUCTION TO VIDEO *$5.85*
This book is for the person who has just, or is about to buy or rent video equipment but is"nt sure what it's all about.

BP78: PRACTICAL COMPUTER EXPERIMENTS *$5.25*

The aim of this book is to enable the reader to simply and inexpensively construct and examine the operation of a number of basic computer circuit elements and it is hoped gain a fuller understanding of how the mysterious computer "chip" works.

BP185: ELECTRONIC SYNTHESIZER CONSTRUCTION *$9.00*

With this book a relative beginner should be able to build, with a minimum of difficulty and at a reasonably low cost, a worthwhile monophonic synthesizer and, also learn a great deal about electronic music synthesis in the process.

BP115: THE PRE-COMPUTER BOOK *$5.85*

Aimed at the absolute beginner with no knowledge of computing, this entirely non-technical discussion of computer bits and pieces and programming is written mainly for those who do not possess a microcomputer but either intend to one day own one or simply wish to know something about them.

BP92: ELECTRONICS SIMPLIFIED - CRYSTAL SET CONSTRUCTION *$5.25*

This is a book written especially for those who wish to participate in the intricacies of electronics.

BP72: A MICROPROCESSOR PRIMER *$5.25*

In an attempt to give painless approach to computing, this inexpensive book will start by designing a simple computer and then the short-comings of this simple machine will be discussed and the reader is shown how these can be overcome. Includes a glossary of microprocessor terms.

BP42: 50 SIMPLE L.E.D. CIRCUITS *$5.85*

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This book is designed to help the user find possible substitutes for a popular user-oriented selection of modern transistors and includes devices produced by over 100 manufacturers.

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The powerful sinclair QL microcomputer has some outstanding capabilities in terms of its internal structure. With a 32-bit architecture, the QL has a large address range, advanced instructions which include multiplication and division.These features give the budding machine code programmer a good start at advanced programming methods. This book assumes no previous knowledge of either the 68008 or machine code programming.

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This book carries on from its predecessor and provides a further selection of useful circuits, mainly of a simple nature. The book is well within the capabilities of the beginner and more advanced constructor.

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Opens out to Wall Chart approximately 584 X 457mm. Includes many Radio & Electronics Colour Codes in use in UK, USA, Europe and Japan. Covers Resistors, Capacitors, Transformers, Field Coils, Fuses, Battery Leads, etc.

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This book deals mainly with TTL type chips such as the 7400 series. Simple projects and a complete practical construction of a Logic Test Circuit Set are included as well as details for a more complicated Digital Counter Timer project.

BP147: AN INTRODUCTION TO 6502 MACHINE CODE *$10.00*

The popular 6502 microprocessor is used in many home computers; this is a guide to beginning assembly language.

BP88: HOW TO USE OP-AMPS *$11.80*

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F.A. Wilson, C.G.I.A., C.Eng.,

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This book provides a number of practical designs for beginners and experienced project builders. These projects utilize a range of modern opto-electric devices, including such things as fibre optics, ultra-bright LEDs and passive IR detectors.

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Relays, bi-directional triodes (TRIACs), and silicon controlled rectifiers (SCRSs), have a wide range of applications in electronics today. This book gives practical working circuits which should present the minimum of difficulty for the enthusiast.. In most of the circuits there is a wide latitude in component values and types, allowing easy modification and adaptation.

BP84: DIGITAL IC PROJECTS *$7.80*

F.G. Rayer, T. Eng. (CEI), Assoc.IERE.

This book contains both simple and more advanced projects for the reader developing a knowledge of the workings of digital circuits. To help the newcomer to the hobby the author has included a number of board layouts and wiring diagrams.

BP95: MODEL RAILWAY PROJECTS *$7.80*

Electronic projects for model railways are fairly recent and have made possible an amazing degree of realism. The projects covered included controllers, signals and sound effects: stripboard layouts are provided for each project.

BP144: FURTHER PRACTICAL ELECTRONICS CALCULATIONS AND FORMULAE *$15.00*

This book covers many aspects of electronics where a knowledge and familiarity of the appropriate formulae is essential for a fuller understanding of the subject. An essential addition to the library of all those interested in electronics.

BP44: IC 555 PROJECTS *$10.00*

E.A. Parr, B.Sx., C. Eng., M.I.EE.

Every so often a device appears that is so useful that one wonders how life went on before it. The 555 timer is such a device included in this book are Basic and General Circuits, Motor Car and Model Railway Circuits, Alarms and Noise Makers as well as a section on the 556, 558 and 559 timers.

BP94: ELECTRONIC PROJECTS FOR CARS AND BOATS *$7.80*

R.A. Penfold

Projects, fifteen in all, which use a 12V supply are the basis of this book. Included are projects on Windscreen Wiper Control, Courtesy Light Delay, Battery Monitor, Cassette Power Supply, Lights Timer, Vehicle Immobiliser, Gas and Smoke Alarm, and more.

BP49: POPULAR ELECTRONIC PROJECTS by R. A. Penfold *$10.00*

Includes a collection of the most popular types of circuits and projects which will provide a number of designs to interest most electronics constructors. The projects cover a wide range and are divided into four basic types. Radio Projects, Audio Projects, Household Projects and Test Equipment.

BP99: MINI-MATRIX BOARD PROJECTS by R. A. Penfold *$7.60*

Twenty useful projects which can all be built on a 24 X 10 hole matrix board with copper strips. Includes Door-buzzer, Low-voltage Alarm, AM Radio, signal Generator, Projector Timer, Guitar Headphone Amp. and more.

BP103: MULTI-CIRCUIT BOARD PROJECTS by R.A. Penfold *$7.80*

This book allows the reader to build 21 fairly simple electronic projects, all of which may be constructed on the same printed circuit board. Wherever possible, the same components have been used in each design so that with a relatively small number of components and hence low cost, it is possible to make any one of the projects or by re-using the components and P.C.B. all of the projects.

BP98: POPULAR ELECTRONIC CIRCUITS, BOOK 2 *$9.00*

R.A. Penfold

70 plus circuits based on modern components aimed at those with some experience.

BP127: HOW TO DESIGN ELECTRONIC PROJECTS *$9.00*

Although information on stand circuits blocks is available, there is less information on combining these circuit parts together. This title does just that. Practical examples are used and each is analysed to show what each does and how to apply this to other designs.

BP195: AN INTRODUCTION TO SATELLITE TELEVISION *$15.00*

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R.A. Penfold

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type material are attracted to the holes in the P-type material and they diffuse together to form a depletion layer which is neutral. This is called a PN junction.

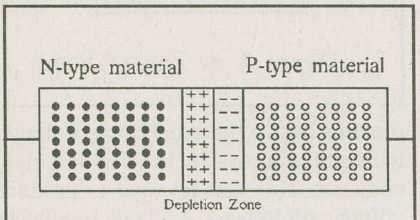

Figure 2. A PN Junction

(See Figure 2) Next we apply a voltage. Figure 3A shows a PN junction with a variable voltage source connected across it. When the voltage is connected as in Figure 3A positive voltage is applied to the P-type material while the negative side of the voltage source is

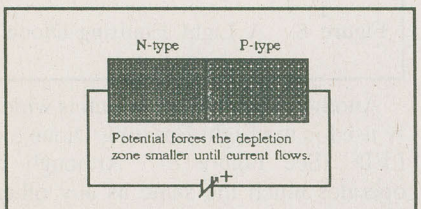

Figure 3A. A Forward Biased PN Junction

connected to the N-type material. The negative potential on the N-type material causes the extra electrons in the material to be pushed toward the junction while the holes are being pushed toward the junction by the positive side of the voltage source. As the voltage is increased, eventually the electrons will gain enough energy to break through the depletion layer and recombine with holes in the P-type material. When that happens conduction will occur.

Okay, but what does that mean?

Simply that when a voltage source is connected that way, after a small initial voltage is overcome the PN junction becomes a low resistance and allows current to flow through it readily. The small initial voltage (for silicon which is the most common material) is about 0.7 volts. (For germanium it is about 0.3 volts.) This is called forward bias.

The other interesting thing that occurs is that when the voltage across the PN junction is reversed (as in Figure 3B), the potentials applied tend to cause

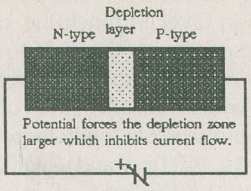

Figure 3B. A Reverse Biased PN Junction

the depletion layer to widen. Positive voltage on the N-type material draws electrons to it widening the depletion layer which is neutral. This stops electrons from flowing through the depletion layer which creates, in effect, a high resistance to current flow. So, when the PN junction is reverse biased it acts like a high resistance and effectively blocks current flow.

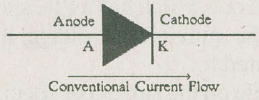

Figure 4. Schematic Symbol of a Diode.

We call this a diode. It conducts in one direction but blocks current flow in the other. Figure 4 shows the standard symbol for a diode with anode (P-type material) and cathode (N-type material) labelled. The anode symbolizes an arrow in the direction of current flow while the cathode symbolizes a blockage of current flow from the other direction.

Diodes are used in lots of common applications: your car's alternator for instance. The alternator works on the principle of moving a conductor through a magnetic field creating a voltage (just like we discussed in the segment on electromagnetism). The voltage generated is alternating, (changing from positive to negative repetitively). The diodes in your alternator are used to convert the alternating voltage into a DC voltage which can be used to charge the battery. When diodes are used for this purpose they are usually called rectifiers because they rectify the AC voltage to DC voltage.

We do the same thing when we convert the alternating voltage available from our 110 volt AC power outlets into DC voltage used in our televisions, radios, stereos, etc. In fact, next month we will be building a bench power supply and using rectifiers to obtain DC voltage from AC voltage. Let's take an advance look at how we'll do that.

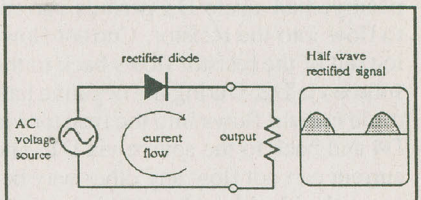

Figure 5A. A Half Wave Rectifier

In Figure 5A you will see a schematic diagram of an AC voltage source, a rectifier, and a resistor to complete a simple series circuit. Because of the characteristic of the rectifier diode, during the time that the AC voltage source is putting out a positive voltage, the rectifier will conduct current around the loop. During the other half cycle, when the voltage source has a negative polarity, the diode is reverse biased and so virtually no current flows. When a rectifier is used this way it is called a half wave rectifier. The voltage dropped across the load resistor is shown as it would look on the screen of an oscilloscope. The voltage is a replica of the positive half of the voltage source waveform.

It would be possible to build our power supply this way, using one rectifier, and half the voltage waveform, and sometimes it is done but this requires a high amplitude of AC voltage to get the DC we want. Another way to rectify the source voltage, and make use of the negative half of the waveform, is

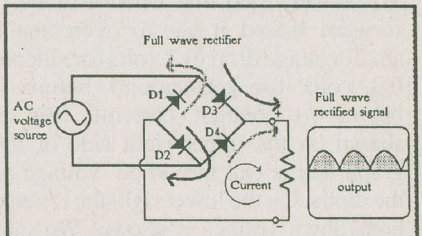

Figure 5B. A Full Wave rectifier

to use the circuit shown in Figure 5B. This is called a full wave or bridge rectifier. Using four diodes in this configuration 'steers' the voltage, whether it is positive or negative from the source, so that it always flows the same

direction through the load resistor. (Bridge rectifiers can be created using four discrete rectifier diodes or can be obtained in a single package with four leads.)

As the arrows indicate during the positive half cycle D3 permits current to flow into the resistor. Current flowing out of the resistor flows back to the source via D2. During the negative half cycle current flows into the resistor via D4 and back to the source via D1. The current can not flow any other way because the blocking characteristic of the diodes prevents the current from flowing in the reverse direction. The oscilloscope diagram shows that both halves of the original AC voltage are supplied to the output, the negative half being inverted positive. The average voltage output is doubled from that in a half wave rectifier.

Having obtained a full wave rectified output, in order to use it for a DC power source filtering must be added to smooth out the ripple. We'll discuss this next month when we consider our power supply project. In the meantime let's look at some other aspects of diodes.

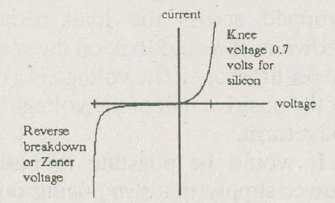

Figure 6. Zener and Knee voltages of a diode

In Figure 6 a graph displays the relationship between the current through and the voltage across a diode. We already said that when a diode is forward biased it has to overcome a small voltage drop (0.7 volts for silicon, 0.3 volts for germanium) before it begins to conduct current. This is shown on the upper right side of the graph and is call the 'knee' voltage of the diode. On the lower right the reverse breakdown voltage is shown. We said that diodes do not conduct when biased in the reverse direction (another way to say it is that the reverse resistance is very high), but if the voltage applied to the diode is increased high enough all diodes reach a point where the depletion layer can no longer withstand the electrostatic force applied across it. At this point electrons 'punch' through the depletion layer in much the same way that a capacitor will break down if too high a voltage is applied across it. The diode, when it reaches this voltage will very rapidly break down; large amounts of current will flow and usually damage will result. (Students of mine sometimes innocently describe this as "letting the smoke out of the diode.")

To avoid damaging diodes by reverse breakdown the correct part should be chosen for each application. (There are lots of different diodes, each designed for particular types of usage.) The reverse breakdown voltage is often given in specifications as the Peak Inverse Voltage, or PIV. This is the maximum reverse voltage the device should be subjected to. Rectifier diodes usually have higher PIV's than small signal diodes and there are wide ranges of PIV values even for rectifiers. Always choose one which has a PIV spec higher than the maximum voltage it will be subjected to.

While on the subject of specifications we should mention that the maximum forward current is another spec which is important to consider. For example, the maximum forward current of a power supply rectifier will be much greater than that of a small signal diode. Along with the higher current rating comes increased size and cost as well as a few other specification trade-offs which we won't get into here.

Before we get too far away from the subject of reverse breakdown voltage we should talk about zener diodes. Another name for the reverse breakdown voltage is zener voltage and because the breakdown characteristic, (shown in Figure 6) is so sharp we can make useful application of this characteristic. If we can predict the breakdown voltage and control the current through the device after we have exceeded that voltage (so that we don't destroy the device) the zener breakdown characteristic can be used as a predictable reference voltage. In other words, if we set up a circuit like the one shown in Figure 7, where the diode is reverse biased into the zener region and the current is limited, the voltage across the diode will be very stable within a certain range of loads and can be used as a voltage regulator. Even if the source voltage varies somewhat (as long as the voltage applied to the zener diode

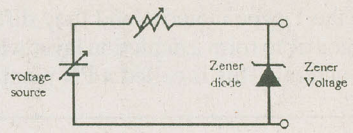

Figure 7. A Zener Diode

remains above the breakdown voltage) the voltage across the zener will remain constant. This can be used to produce voltage references, voltage regulators for power supplies, and many other uses.

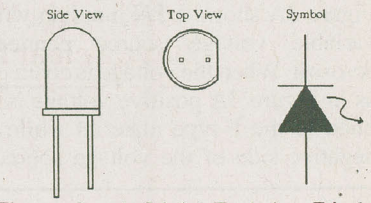

Figure 8. A Light Emitting Diode

Another type of diode which is widely used is the Light Emitting Diode, or LED. (See Figure 8) Although it operates much the same as any other diode, because of the semiconductor materials and doping materials chosen in it's manufacture, it emits light when forward biased with current flowing. The intensity of the light is proportional to the current level. Of course we see these all over the place: displays, calculators (the older ones at least), intelligent displays, etc. The only real difference electronically is that the forward voltage drop is higher than 0.7 volts depending on the material used to get a particular colour, size or intensity. Some forward voltage drops are over 2 volts.

As simple as diodes and rectifiers are, there is a lot that could be said about them. There are thousands of applications and almost as many specific part numbers for diodes and specifications differing from one to the next. We'll be talking more about them in future segments of this series and some of the practical aspects of the uses should come out then.

Next time: a simple DC power supply you can build. ❐

C Programming for Techies

Bits, the most fundamental element of data, can be tricky to deal with. While C offers some bitwise operators, unless you have a clear fix on what they're up to, bits may still escape you.

by Steve Rimmer

Bitwise manipulations under C language programs can be confusing. In many applications it would be convenient to deal with byte oriented data objects as bit fields... something C isn't really set up to let you do. However, if you really understand what's happening at the bit level of C's operations you can make it do a lot of clever, and hitherto unexplored, things.

Unfortunately, bitwise operations are exceedingly hard to fathom at first, and their operators under C are among the most obtuse.

This month we're going to look at some of the mechanics of bits and C.

Bits of Data

A bit is, of course, a simple binary object. Bits can be either on or off. In binary notation... something which C doesn't actually support... a bit that's off is represented by zero and a bit that's on is represented by one.

In microprocessor based computers a byte has largely standardized on being eight bits wide. This isn't true in other environments. If you read through some of the obscure parts of Kernighan and Ritchie's book *The C Language*, you'll find reference to mainframe environments with odd sized bytes. However, you can probably ignore the possibilities of a mainframe system in your basement for the time being.

An eight bit byte can be regarded as being comprised of two nybbles, each having four bits. This works out well when you look at the hexadecimal notation for a byte... something most PC based C compilers *do* support. Here's the binary representation of a byte:

```
11000111
```

and here's its hexadecimal representation:

```
0xc7
```

This works out to two nybbles in both cases. The upper nybble of the byte is 1100 in binary and 0xc in hexadecimal. This is twelve in human numbers.

You only really need to know sixteen values, then, as both nybbles work the same way.

```
DecimalBinaryHex
000000
100011
200102
300113
401004
501015
601106
701117
810008
910019
101010A
111011B
121100C
131101D
141110E
151111F
```

C provides a rich set of operators to deal with bits. These bitwise, or *boolean* operators allow you to both test and manipulate bits. However, using them effectively calls for a bit of cunning.

The most commonly used... and most frequently misapplied... operator is AND, represented by &. The AND operator will return a value which contains those bits which are common in the two objects being ANDed together. As with all C language bitwise operators, you can AND *char*s, *int*s and *long*s. For the moment, we'll work with *char*s, which are equivalent to bytes.

Here's an example of the use of AND.

```
int a=0xc7,b=0x7f;

printf("a AND b = %X",a & b);
```

Let's see what this should do. The binary representation of this expression would be:

```
a = 11000111
b = 01111111
```

The result will be a byte having its bits set in those positions where both *a* and *b* also have them set.

```
r = 01000111
```

This has a hexadecimal value of 0x47.

There are a number of obvious uses for the AND operator. It works as a crude... but fast... form of modulus operator if you want to take the modulus of an integer and the modules happens to be an even power of two. For example, you could replace *n % 8* with *n & 7*.

The AND operator is also used to mask off unwanted bits. For example, older versions of WordStar produced text files which were essentially pure ASCII save that some of the characters had their most significant bits set as a signal to some of WordStar's internals. You could turn a WordStar file back into an ASCII file by ANDing every byte with 0x7f. This value has all its bits set save for the most significant one.

It's probably worth pointing out the difference between the bitwise AND operator and the logical one under C. The former is *&* and the latter is *&&*. This often sneaks up and bites you somewhere private if you forget about it. For example, consider this conditional statement.

```
if(a && b) {
/* some code goes here */
}
```

This means to do whatever's in the conditional if both *a* and *b* are non-zero. Occasionally people forget the second ampersand.

```
if(a & b) {
/* some code goes here */
}
```

This means to do whatever is in the conditional if *a* AND *b* works out to a non-zero value, that is, if *a* and *b* have some bits in common. This can be a very hard bug to track down.

The OR operator is represented by the vertical rule character, /. It will return a value which contains set bits in all those positions which had them set in either argument to it. For example,

```
int a=0x38,b=0x81;

printf("a OR b = %X",a | b);
```

Once again, we can see how this works if we look at the two values in question in binary.

```
a = 00111000
b = 10000001
```

The result, then, would be

```
r = 10111001
```

This works out to 0xb9.

Once again, there's a logical OR operator, //, which should not be confused with the bitwise one.

The exclusive OR operator is perhaps the most confusing and the least used. It's represented by the carat character, ^. Fortunately, there is no logical exclusive OR operator to muddy the waters. The operation of the exclusive OR function is to invert bits.

If *a* and *b* are bytes, *a ^ b* will cause all the bits in *a* to be inverted wherever there are set bits in *b*. Let's see how that works.

```
int a=0x0f,b=0x55;

printf("a XOR b = %X",a ^ b);
```

Once again, we can work out the whole seething mess in binary.

```
a = 00001111
b = 01010101
```

The result would be

```
r = 01011010
```

This amounts to 0x5a in hexadecimal.

The exclusive OR operator is useful for toggling bits.

Finally, there's the negation operator, which is represented by the tilde character, ~. This simply inverts all the bits in a byte. These two expressions will produce the same result... you might want to stop and see if you can figure out why.

```
b = ~a;
b = a ^ 0xff;
```

This assumes in both cases that *a* is a *char*.

Aside from being able to manipulate bits under C, you can alter their positions in a byte. There are two operators for this, the left shift operator, << and the right shift operator, >>. These often get confused with the greater than and lesser than logical operators, with the same sorts of results as the confusion about the logical and bitwise AND operators discussed above.

Shifting bits involves moving all the bits in an object left or right by a defined amount. For example,

```
int a=0x34;

printf("a shifted left
one = %X\n",a << 1);
printf("a shifted right
one = %X\n",a >> 1);
```

Turning once more to the binary representation of things,

```
a = 00110100
```

In order to shift *a* left, we must lose the leftmost bit and add a zero bit onto the right end of the byte.

```
r = 01101000
```

This works out to 0x68.

To shift *a* right by a bit, you would do the opposite, that is, throw away the rightmost bit and add a zero bit to the left end.

```
r = 00011010
```

This works out to 0x1a.

The decimal values for these numbers may be more enlightening. The original value of *a* was 52. Shifted left by one it became 104. Shifted right it became 26.

Each time you shift a value left by one place, you multiply it by two. Each time you shift it right by one place you divide it by two. If you have to perform integer multiplication or division by even powers of two, using bit shifts is eminently more desirable than using normal integer math. A bit shift will typically take about a fiftieth of the processor time of a multiplication or division instruction.

Plowing the Bit Fields

In working with applications which require a lot of bitwise manipulation... especially in dealing with bitmapped graphics... you will usually find that you have to treat a string of bytes as a string of bits. For example, if you want to set a pixel on a graphics screen, you must locate the pixel in question in the line of bytes which makes up the screen line in memory.

In the following examples, *n* will be the location of the bit to be dealt with a *p* will point to the line of bytes which contains the bits in question.

Finding the byte which contains bit *n* in the bit field is easy. Since there are eight bits in a byte, bit *n* must reside somewhere in the byte numbered *n / 8*. Because eight is an even power of two... the third power... we can make this calculation much faster by representing it as *n >> 3*. The byte in question, then is *p[n>>3]*.

Finding the bit in question in the specific byte requires a bit more stealth. We wish to create what's called a *mask*, a byte having a single bit set representing the position of the bit in question. This can be done using the expression (0x80 >> (n & 7)).

Let's see what's going on here. The value 0x80 is a byte having one bit set, this being its most significant bit. The expression *n & 7* is, in fact, *n* mod eight, or the portion of the bit position value *n* which represents the bit position in the byte in question. Note that when we found the byte by shifting *n* right by three, the bits masked by the value seven... the first three... are the ones which were thrown away.

This is how you would turn on bit *n* in bit field *p*.

```
p[n>>3] |= (0x80 >> (n & 7));
```

This expression will locate the byte which bit *n* resides in and create a mask to represent the appropriate bit. It will then OR the byte with the mask. The single bit which is set in the mask will turn on the corresponding bit in the byte in question. If the bit is already on, nothing will happen.

This is how you would turn off bit *n* in bitfield *p*. It's a bit more involved.

```
p[n>>3] &= ~(0x80 >> (n & 7));
```

To turn off a bit, we must mask off that bit. You could so this by ORing the bit to make sure it was on and the exclusive ORing it to turn it off. An easier way is to use the same mask as we did in turning the bit on and inverting it, such that it becomes a mask selecting all the bits except for the one in question. If we AND this with the byte in question, the bit to be turned off will be masked, or set to zero.

Finally, this will toggle bit *n* in bitfield *p*. Note that this expression does not know the state of bit *n*... it simply inverts it.

```
p[n>>3] ^= (0x80 >> (n & 7));
```

Just a Bit Faster

Code optimization... the process of trying to streamline a program to make it run faster... would look at the foregoing expressions a bit suspiciously. Bitfield operations usually involve a lot of bits, and there seem to be more operations in these expressions than there need be. Code optimization invariably tries to pre-package some of the computations in a complex expression into a table. This is one of those cases wherein you can speed things up with one.

Consider the expression *(0x80 >> (n & 7))*. It has two actual operations going on, to wit, ANDing *n* by seven and then shifting 0x80 right by the result. It can only produce eight possible results. We can speed up all the aforementioned bitfield operations by creating a table of mask values. Here it is.

```
char masktable[8]=
0x80,0x40,0x20,0x10,0x08,0x0
4,0x02,0x01;
```

We can the reduce the expression by one operation. It becomes *masktable[n & 7]*. Hence, to turn on bit *n* in bitfield *p*, you would say

```
p[n>>3] |=masktable[n & 7];
```

As you begin to work with bitwise operators under C you'll probably find a wealth of uses for them. Aside from speeding up some multiplication and division operations, they provide a powerful way to compress the space you need to store flags, small numbers, pixels and other things which don't fit neatly into the rigid confines of a byte. ❐

FEATURE

Build a Universal Controller For Small DC Motors:

An Introduction In Designing Intelligent Machines

by Donald Wilcher

Out on the market, there are a series of electronic control robots known as MOVIT® available to hobbyists and experimenters. These toy robots employ sound or infrared sensors to detect objects in their path and upon detecting these objects will change their direction. Some of the MOVITs have on board computers, making them programmable. With the use of sensors and a microprocessor to interpret the data picked up from the sensors, these machines are capable of making decisions (e.g. to avoid an object or to track a pencil marked line) about their environment. The focus of this project is to introduce to the reader how such machines are capable of motion based on the data obtained from their sensor(s) and how this information is delivered to the machine's motor drive mechanism. Besides discussing methods of motor control, a Universal Controller for small dc motors (in the range of 1.5 - 12 VDC) will be introduced along with a design example of an intelligent machine.

DC Motor Control Basics:

The ability to start or stop a motor is basically no more than adding a switch to the circuit. Fig. 1 illustrates a simple start/stop circuit for controlling a dc motor. The basic operation of this circuit is, with the switch open, dc current is unable to flow through the motor windings. With no I_a (armature or motor winding current) present, the motor doesn't rotate. If the switch is closed, I_a flows through the motor windings allowing the rotor to rotate from the stator thus producing motion in the shaft of the motor. This circuit is adequate if one direction of rotation is required but will not suffice for bidirectional motion. Fig. 2 illustrates how bidirectional control of a motor can be accomplished. Simply, by closing SW1 and leaving SW2 open, I_a flows and the motor's shaft rotates in one direction. If SW2 is closed and SW1 is open, we now have a $-I_a$ and the motor rotates in the opposite direction. Closing SW1 and SW2 together is not permitted because the power supply source for the circuit will be shorted out (i.e. +5-5 = 0V). This design scheme is better than the first one but its main drawback is its manual mode of operation. A human interface of some sort must be utilized in manually opening and closing switches 1 or 2. The solution to this problem is to use electromechanical relays. Simply explained, with the coil of the relay ener-

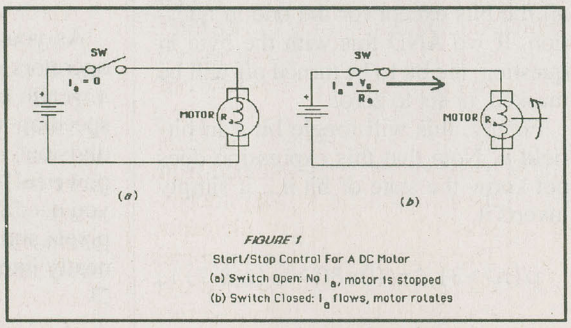

FIGURE 1
Start/Stop Control For A DC Motor
(a) Switch Open: No I_a, motor is stopped
(b) Switch Closed: I_a flows, motor rotates

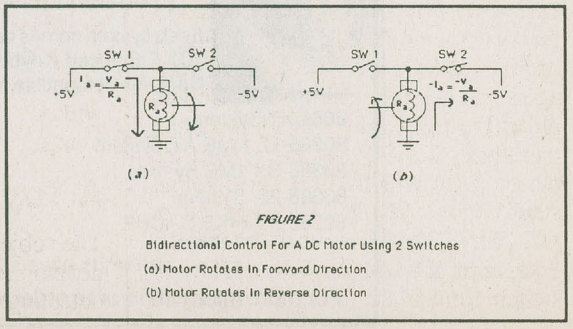

FIGURE 2
Bidirectional Control For A DC Motor Using 2 Switches
(a) Motor Rotates In Forward Direction
(b) Motor Rotates In Reverse Direction

gized the contacts switch from normally open to closed contacts automatically. This feature of automatic switching ties into the design concept of intelligent machines. The main objective of an intelligent machine is to allow the system to make a decisive response based on the information it has obtained

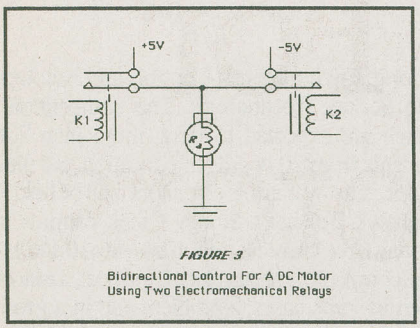

FIGURE 3
Bidirectional Control For A DC Motor Using Two Electromechanical Relays

from the environment. Fig. 3 shows a bidirectional control circuit using electro-mechanical relays.

Universal Controller Components

Now that we have a basic understanding of how a dc motor can be controlled in terms of motor shaft direction (forward/reverse), we have the knowledge to build a motor drive circuit which can be applied to any device or machine that needs to change direction or motion. A Universal Controller is basically a modified circuit of what was

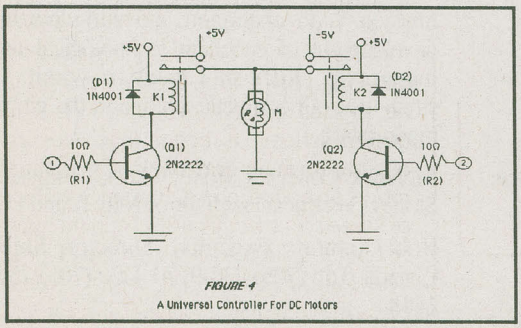

FIGURE 4
A Universal Controller For DC Motors

discussed in Fig. 3. Fig. 4 shows the basic circuit of the Universal Controller for dc motors. The circuit in Fig. 4 operates as follows: With no input voltage applied at pt. 1, VB1 is 0V. Collector to Emitter Current (ICE) is also 0, therefore, K1 is not energized; the motor (M1) will be in a non-rotating state. Upon voltage being applied at pt.1 (VIN .7V) ICE is generated thereby energizing K1. The contacts of K1 will switch from N.O. (normally open) to closed contacts allowing I_a to flow. With I_a flowing, the motor's rotor rotates and motion is thereby induced. If an input voltage is applied at pt. 2, circuit operation is the same except the motor's shaft will rotate in the opposite direction. Diodes D1 and D2 are used to suppress inductive spikes generated by the energization/de-energization of the relay coils. If input voltages are applied to pts 1 and 2 simultaneously, relay contacts K1 and K2 will short out the power supply. Therefore, applying voltages at both Q1 and Q2 BASES are not allowed. If higher rated motors are required, the contacts for K1 and K2 should be rated accordingly to handle this voltage value. As mentioned previously, this circuit can be applied to any device or machine that requires motion.

Introduction To Intelligent Machine Design

An intelligent machine is a device or system capable of making decisive responses based on the data obtain from the environment. The decision-making response is based upon a software/µP (microprocessor) elements system which obtains data from its sensor(s) and processes this information to produce the corresponding output. Some machines may have the ability to make decisions based on the data obtained from the environment but may not possess the software/µP elements. The reason for these machines being able to make decisive responses is due to the circuit configuration and logic incorporated into the system. The following example will give a hands-on approach in designing and developing an intelligent machine using the Universal Controller as the main motor drive mechanism and without the use of software/µP elements.

A Toy Robot Walker

The objective of this project is to develop a motorized walker that upon detecting light will initiate motion either in the forward or reverse direction. In this project, the ROBOTIX® Construction Set made by Milton Bradley will be used in constructing this

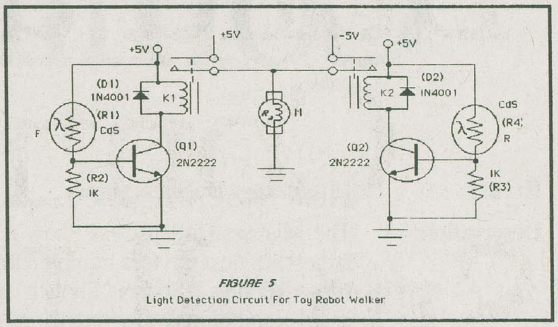

FIGURE 5
Light Detection Circuit For Toy Robot Walker

machine. Although the ROBOTIX Construction Set was used, the techniques presented here can be applied to other motorized construction sets as well. The ROBOTIX Construction Set consists of 4 motors, a remote control console and an assortment of plastic couplings, beams and wheels. With the number of parts available, a 4-axis robot can be constructed and, with the use of a personal computer and software, the machine can be programmed to perform manipulative tasks. The Light Detection Circuit for the walker is shown in Fig. 5. The circuit operates in the same manner that was described under the Universal Controller Components Section. The CdS (Cadmium Sulphide) or photocells along with the 1K resistors form voltage dividers which provide input voltages to the bases of the NPN transistors Q1 and Q2. With light present on R1, the walker moves forward and with light on R4 the machine moves backward. As discussed earlier, the photocell sensors pick up the data (i.e. light) and send this information to the Universal Controller. The Controller then makes the decision either to move forward or backwards based on this data; therefore a simple intelligent machine has been created.

Construction Notes

The circuit in Fig. 5 was built on a solderless breadboard and circuit operation validated. The photocells were separated "x" inches apart so that the beam of light would not energize both K1 and K2 relays at the same time. For best results, cardboard tubing placed over both photocells will im-

see **Controller**, *page 38*

Coming Events

Event: **Mississauga Business Show**

Description: The Mississauga Business Show is Canada's largest business services, equipment and supply show. Thomas J. Sockett, Show Manager with ECM Exhibition & Conference Management Ltd., says, "This year's theme, '10 Years of Growing Success', is appropriate for many reasons. A lot has happened over the last 10 years, for communities and businesses as well as the show itself. The Mississauga Business Show has undergone a transformation, having grown from a local trade show to an international event that attracts exhibitors and attendees from Canada and the United States.

"This year's feature areas will be a tribute to the phenomenal growth and change that has happened over that time." he adds. "And we're encouraging exhibitors to become actively involved in promoting our theme. For most exhibitors, the nostalgic approach to the 1991 event can provide a unique opportunity to add a new dimension to their displays. By displaying products and/or memorabilia from 10 years ago, they can attract even more visitors than ever before. Everyone is interested in seeing just how much businesses and services have changed in such a short space of time, and with the active involvement of all the exhibitors, we can make this one of the most dynamic and exciting shows ever. This excitement will translate into a more productive and profitable event for everyone."

Date & Place: April 10 & 11, 1991, International Centre, Toronto, Ontario

Contact: ECM at Tel: (416) 274-5505 Fax: (416) 274-0060

Event: **Skills Canada 1991 Ontario Skills Competitions**

Description: The best of Ontario's technical and trades students from high schools and community colleges across the province will be honing their skills for the Skills Canada 1991 Ontario Skills Competitions in May. The second annual provincial competitions will draw some of the most promising technical students from both secondary schools and colleges, competing in their trade areas. These trades include categories such as, Electronics Technology, Residential Wiring, Environmental Controls and Automotive Service Technology. The competitions, which are expected to draw more than 200 students from 20 boards of education and nine colleges, as well as lots of visitors, will be held at Mohawk College's Stoney Creek campus in Stoney Creek near Hamilton on May 10 and 11.

The competitors are assigned a project, a task or even in some cases, a problem and in a given time frame have to produce the end project or repair. In the 190 competitions, for example, the wiring competitors were required to do a timed installation of residential wiring. The judging is done by representatives from business, industry and labour organizations.

The provincial Skills Competitions recognize students from participating schools who demonstrate their technical and leadership skills in different subject disciplines in a supervised, friendly and competitive environment.

There will be 20 events, including a number at the post-secondary level. Everyone is welcome to visit and observe the competitions.

Skills Canada is a national, voluntary association with members from business and industry, labour organizations, educators and students. Its mission is to champion and stimulate the development of excellent technological and leadership skills in Canadian youth, to strengthen our competitive edge in the global marketplace.

Date & Place: Mohawk College's Stoney Creek campus in Stoney Creek near Hamilton on May 10 and 11.

Contact: Bob Connors, Executive Director, Skills Canada Tel: (705) 734-9170 Fax: (705) 734-1448

Event: **INTELECT** International Electrical Conference & Exhibition

Description: INTELECT is Canada's first international, multi-faceted electrical conference and show for senior specifiers and buyers of electrical equipment. Technical and business conferences will offer the latest in technological developments and practices. Major electrical manufacturers and suppliers will have the experts on hand to demonstrate all aspects of electrical products and services.

Date & Place: June 10, 11, & 12, 1991, Metro Toronto Convention Centre, Toronto, Ontario

Contact: Kerrwil Show & Conference Group, 395 Matheson Blvd., East, Mississauga, Ontario L4Z 2H2 Tel: (416) 890-1846 Fax: (416) 890-5769.

Event: **ICFA '91** International Conference and Exhibits on Failure Analysis

Description: Co-sponsored by ASM International and the ASM Montreal Chapter, ICFA '91 will focus on all steps of the failure analysis process including theoretical and practical aspects.
Call For Papers:
Technical presentations are sought on the subject of failure analysis in the following areas: fracture mechanics; novel and unusual techniques; applications in the aircraft, transportation, and petrochemical industries; non-metallic and composite materials; legal aspects; fractography; applied testing; large structures; electronic devices; and surgical implants. Case studies presented at the conference will examine a variety of components, products, and systems involved in these fields.
Also featured during ICFA '91 will be exhibits aimed toward materials engineers, scientists, and metallurgical and chemical engineers involved in the areas of electron microscopes: SEM, STEM, TEM, Scanning Tunnelling, and Digital; X-Ray Analyzers: wavelength, energy, and auger, image analyzers; tools for microanalysis; P.C. software for image analysis, laboratory management; general metallographic equipment; optical microscopes; and etching equipment and chemicals.

Date & Place: July 8-11, 1991 in Montreal, Quebec

Contact: ASM Member/Customer Service Center, ASM International, Materials Park, Ohio 44073 Tel: (216) 338-5151 Fax: (216) 338-4634.
Abstracts of 300 words should be sent before 1 February 1991 to Eugen Abramovici, Section Chief, Materials and Processes Engineering Laboratory, Canadair Aerospace, Bombardier Inc., P.O. Box 6087, Station A, Montreal, Quebec H3C 3G9 Tel: (514) 744-1511 Fax: (514) 744-6586

Event: **NetWorld91**

Description: NetWorld is an international networking and connectivity trade show servicing the purchasing, educational and marketing needs of the industry. Networld returns to Boston for its third engagement, with a larger exhibit floor and expanded Seminar Series. NetWorld 91 Boston will feature at least 300 exhibitors and more than 20,000 attendees. Attendees include trade resellers, network communications managers, MIS/DP directors, engineers of technical services, data communications planners, systems analysts, and consultants. NetWorld will again offer intensive, all-day tutorials on February 11 — instructional sessions from networking experts

Date & Place: February 12-14, 1991, John B. Hynes Convention Center, Boston Massachusetts

Contact: Bruno Blenheim, Inc., Trade Show Management, 385 Sylvan Ave., Englewood Cliffs, NJ 07632 Tel: (201) 569-8542 Fax: (201) 569-6375

Event: **NEMDE'91**

Description: NEMDE '91 is the first pure electronic manufacturing conference to be held in the Midwest. The new program will be held in conjunction with the first National Electronic Manufacturing and Design Exposition — NEMDE'91.
Show Manager, Michele Filippi explains the positioning of this new program. "Our NEPCON events have provided complete electronic manufacturing conferences on the West and East coasts for over 28 years; now we are bringing a pure electronic manufacturing conference to the Midwest market."
The Conference Program which has been developed by NEPCON Conference Manager Mike Critser, will include 14 technical sessions, 12 workshops, and 8 professional advancement courses. Featured sessions will include *Design For Thermal Management* presented by John Lau of Hewlett Packard, *Functional Test* chaired by Ken Johnson of ASTE, *Infrared Reflow Soldering Considerations* conducted by Phil Zarrow of Vitronics Corporation, and *Surface Mount Soldering and Cleaning for the 1990's An Update* presented by renowned industry consultant Howard Manko.

Date & Place: April 8-11, 1991 at McCormick Place, Chicago, Illinois

Contact: Michael Critser, Conference Manager, at Cahners Exposition Group, 1350 East Touhy Ave., Des Plaines, Illinois 60018 Tel: (708) 299-9311 Fax: (708) 635-1571. For information about attending and/or exhibiting at NEMDE '91, please contact Michele Filippi, Show Manager, at the same address and phone. ❐

Industry News

Firm Wins $2 Million Contract to Monitor Noise at Toronto Airport

MISSISSAUGA — Bruel & Kjaer Canada Limited of Pointe Claire Quebec has been awarded a contract worth almost $2 million to provide Lester B. Pearson International Airport with one of the most advanced noise monitoring systems in existence. The monitoring system consists of microphones strategically located around the airport linked with a series of sophisticated noise analyzers which store data on each sound event. The equipment is designed so that it can operate under virtually any weather conditions. Once this data is analyzed by computer, airport officials can determine just which flight patterns should be established to provide the least amount of disruption to people in the vicinity. "By taking this step, the airport authorities have shown they have a very real concern for the residents of the area and intend to do everything possible to minimize any discomfort caused by airport noise," says Andrew McKee, president of the Canadian company. "The approach has worked well in other parts of the world and we have every expectation that it will be a great success in Canada's busiest airport."

Bruel & Kjaer Canada has provided similar systems to airports in Calgary, Edmonton and Vancouver. However, the Toronto system is by far the largest ever installed in Canada. For more information contact: Andrew McKee, Bruel & Kjaer Canada Ltd., 90 Leacock Road, Pointe Claire, Quebec H9R 1H1 Tel: (514) 695-8225.

Hong Kong's 'Silicon Valley' Unveiled

Motorola's New Silicon Harbour Center Demonstrates Confidence In Hong Kong

Motorola Semiconductors HK Ltd. officially opened its high-tech electronics design and manufacturing center in Hong Kong today (Dec. 4), and it is Hong Kong's answer to the world famous Silicon Valley. "Motorola has taken Hong Kong another step forward in electronics technology," said Hong Kong's Chief Secretary, Sir David Ford, at the ribbon cutting ceremony today.

Silicon Harbour Center clearly demonstrates Motorola's confidence in Hong Kong as a place where high-technology manufacturing can grow and thrive, said Sir David.

Motorola's highly automated 326,000-square foot, three-story Silicon Harbour Center was built to service electronics manufacturers throughout the Asia Pacific Region.

The facility, located at the Taipo Industrial Estate in the New Territories section of Hong Kong on the mainland, contains Motorola's Asia Pacific headquarters and integrated circuit design and manufacturing centers for state-of-the-art semiconductors such as ASIC, BiPolar and MOS integrated circuits.

Silicon Harbour Center will design and manufacture a wide range of leading edge semiconductors, using the latest computer-aided design/computer-aided manufacturing/computer-integrated manufacturing (CAD/CAM/CIM) technology.

The high density dynamic RAM memories, complex applications specific circuits (ASIC) and BiMOS and bipolar integrated circuits produced at Silicon Harbour Center will give the regional electronics industry a much-needed boost.

The multi-million-dollar project is a calculated attempt to duplicate the unprecedented success of California's Silicon Valley in the Asia Pacific Region, according to the driving force behind Silicon Harbour Center, Mr. C.D. Tam Corporate Vice President and General Manager of Motorola's Asia Pacific Division.

"The world has all ready seen what happens when a number of highly creative minds gather together in an area like Silicon Valley," Mr. Tam said. "We felt that the same excellent results could be generated if a similar project was started in an Asia Pacific region which houses some of the world's most dynamic minds and economies." Mr. Tam said the design and manufacturing technologies used in Silicon Harbour Center are one generation ahead of similar facilities in the United States and Europe." "The emphasis is on producing high-quality semiconductors of increasing complexity in the shortest possible cycle time," Mr. Tam said, "thus helping the local and regional electronics manufacturers in particular move into the current generation of modern circuitry and product miniaturization." Hong Kong was chosen as the site for the Silicon Harbour Center because of its abundance of technical talent, excellent telecommunications links with the rest of the region and its strategic location as the gateway to China. "From Hong Kong, Motorola can reach out to an Asia Pacific network that stretches from Korea in the north to Melbourne in the south from Penang in the west to Manila in the east," Mr. Tam said. "The Asia Pacific region is currently the fastest growing area in the world for chip consumption with an almost insatiable demand for semiconductors of all shapes and sizes." Mr. Tam noted that although a worldwide recession appears likely during the next

couple of years, the Asia Pacific region is still generally expected to overtake Europe as a semiconductor market by the middle of the decade." "Translated into U.S.-dollar terms, that means electronic manufacturers throughout Asia and the Pacific will be buying some US$14 billion worth of product by 1995," Mr. Tam said. "Much of this phenomenal output will be swallowed by the four dragons — Hong Kong, Taiwan, Singapore and South Korea — whose meteoric rise to wealth and prosperity has fuelled the region's dynamic growth." The four dragons remain the key to markets which will see the most explosive expansion as they begin to move into higher-end, leading-edge products that challenge the traditional leadership role of the U.S. and Europe, according to Motorola. "This, in turn, will mean that lesser-developed areas such as Thailand and Malaysia will gradually assume the task of assembling the lower-end items," said Mr. Tam. "China, too, has a large role to play in the future development of the regional electronics industry, though it will only begin to achieve its immense potential as an international manufacturing and production center toward the end of the century." Sir David said Motorola decided to set up its Silicon Harbour Center in Hong Kong because of the territory's attractive central position with respect to other semiconductor customers in the Asia Pacific region, the availability of technically-skilled staff and the territory's proximity to a potentially enormous China market. "These same factors have influenced many overseas investors to come to Hong Kong," Sir David said. "Hong Kong's geographical location, its free trade and free enterprise policy, its hard-working and efficient labour force, its low taxation rate, and its excellent communications network are constantly cited by overseas investors as Hong Kong's attractions as a manufacturing base." The Asia Pacific region is considered one of the world's fastest growing electronics production areas with Hong Kong, South Korea, Singapore and Taiwan in particular showing growth over the past few years. "Growing demands for perfect quality, on-time delivery, JIT (just-in-time) product supply and fast turnaround of custom or ASIC designs make the Silicon Harbour Center concept a viable proposition," Mr. Tam said. "Motorola is confident that the Silicon Harbour Center will make a direct contribution to local and regional electronic industries by providing the very latest semiconductor technology for its customers throughout the Asia Pacific area," he said.

NRC Creates New Science and Engineering Training Program for Women

OTTAWA (Nov. 29, 1990) — The National Research Council today announced the creation of a new training program to encourage Canadian women to pursue careers in science and engineering, Details of the NRC Training Program for Women in Science and Engineering were provided at a news conference by NRC president Dr. Pierre Perron, and The Honourable Mary Collins, Minister Responsible for the Status of Women, Under the program, NRC will provide both financial assistance and career-related training to promising women enroled in undergraduate studies in science and engineering at Canadian universities. Chosen candidates will participate in the program for three years. They will receive $10,000 in the first year, $12,000 in the second, and $15,000 in the third. Each year, a minimum of 25 first-year applicants will be added to the program. NRC would thus have a complement of at least 75 students enroled in the program by the third year. This number could be expanded as available resources permit. Priority will go to students enroled in disciplines, such as physics, mathematics, and engineering, in which women have traditionally been under-represented. The NRC program is intended to stimulate the interest of women in research, assist them in pursuing their studies at the undergraduate level, and encourage them to obtain advanced degrees in science and engineering. NRC's plans have received enthusiastic support from both the Minister Responsible for the Status of Women, and the Honourable William Winegard, Minister for Science. "Studies show women as significantly under-represented both in enrolments and among graduates in most scientific and engineering disciplines", explains Mrs. Collins.

"Further, Canada is facing a shortage of qualified researchers in many of these fields," says Dr. Winegard. "Increasing the number of women researchers makes a lot of sense and is a key part of the solution."

"Through this program, NRC will use its unique facilities and world class expertise to help meet Canada's needs for highly qualified personnel," adds Dr. Perron. "I am very pleased that we are launching this training program in conjunction with NRC's 75th anniversary celebrations next year."

A call for nominations to the program will go out to universities and CEGEP's in December, 1990. Potential candidates apply through their university in their first year of undergraduate studies (last year of CEGEP in Quebec). The institutions will inform NRC of their nominations by February, 1991. An NRC Committee will make the selection and announce successful candidates by May, with training beginning in September, 1991. An NRC Research Officer will be assigned as supervisor or sponsor for each student in the program. This supervisor will act as a mentor to provide advice and guidance during their stay with NRC. Students will be hired as employees of NRC for the duration of their stay in the program. For part of the year, students will be full-time at a university. During the summer, or for a coop term, students will be at NRC or with an NRC partner on a career-related work assignment. The NRC Training Program for Women in Science and Engineering is an integral part of NRC's commitment to do its part in training the highly skilled scientific and engineering workforce Canada needs. This commitment is an important thrust of NRC's new long-range plan (1990-95).

The National Research Council, Canada's leading research and development agency, provides a comprehensive network of ser-

vices, facilities, technology transfer programs, and collaborative research opportunities in support of Canadian science and industry. Drawing on the scientific and technical expertise of its multidisciplinary laboratories across the country, NRC helps Canadian firms develop and maintain high standards of excellence and international competitiveness. For more information contact Patricia Montreuil, Information Services (613) 993-4848

INTER COMM 90 Gets Top Marks

VANCOUVER: INTER COMM 90, the first International Congress and Exhibition on Global Telecommunications, was an overwhelming success with industry researchers, government officials, PTT representatives, and manufacturers. Officially opened by Prime Minister Brian Mulroney, INTER COMM 90 occupied the Vancouver Trade & Convention Centre from October 23 - 26.

The international exhibition drew over 5,000 visitors and featured 162 companies. Boasting an impressive roster of international guest speakers, the congress portion attracted more than 700 delegates to 32 sessions exploring topics ranging from networking and technological advances to regional and global telecommunications policy.

Y. Iida of NEC, said, "We were really impressed that there were so many more international buyers here than we had expected and we were able to make contacts with systems designers and commercial buyers in Latin America, Africa — throughout the world. INTER COMM 90 was very effective for us. We'll be back in '92."

Maureen St. John of Newbridge Networks added, "The show was fantastic. The quality of buyers was great; there were lots of high-level people... There was definitely international interest here." Given the response from congress and exhibition attendees, INTER COMM organizers have already laid in the groundwork for the next international congress and exhibition in Vancouver Oct. 27 - 30, 1992. Project Manager Kathie Moseley said, "INTER COMM 92 will continue to keep up the dialogue and monitor this fast changing industry. The next show will see an expanded range of topics for the international congress and an increased emphasis on attracting more international buyers to the exhibition."

Exhibitor Sandra Perrin of Redcom noted, "This show had good quality people throughout. It was well organized and the staff cooperative. INTER COMM 92? We'll be back!"

Inmarsat-2 Satellite Up .. And Running

Inmarsat-2, the new commercial global mobile communications satellite, launched from Cape Canaveral, Florida on October 30, is now in geostationary orbit with all systems operating normally. In fact, early operations on the satellite have gone so well, that command of the spacecraft was handed over from the Centre National d'-Etudes Spatiales (CNES) in Toulouse, France to Inmarsat's satellite controllers ahead of schedule. CNES performed the initial manoeuvres and checks on the satellite using a chain of telemetry, tracking and command stations around the world.

The satellite, the first designed and built specifically to provide commercial mobile communications services for ships at sea, aircraft in flight and land mobile users, was built by an international consortium headed by British Aerospace and launched aboard a Delta II rocket.

On Tuesday, November 13, the satellite's communications payload was turned on, and the first signals sent and received via the satellite's two transponders. Testing of the communications payload will continue for the next couple of weeks.

Immediately following the launch, the satellite's apogee engine was fired three times, placing it precisely in its predicted geostationary orbit.

Other manoeuvres successfully completed include activating the satellite's momentum wheel, which is one of the mechanisms to provide the spacecraft's three-axis stabilization.

"After a perfect launch, the satellite and Inmarsat's ground systems have been performing flawlessly," said Ahmad Ghais, director of Engineering and Operations for Inmarsat "We expect to have the satellite ready for service by mid-December, well ahead of the Christmas rush in communications." Ghais also said that the precision with which the satellite manoeuvres had been performed may lead to some fuel savings and a lengthening in the satellite's serviceable lifetime.

The range of services offered by Inmarsat, the London-based 62 member country international cooperative, includes telephone, facsimile, electronic mail, telex, data and position reporting and fleet management, as well as distress and safety communications, for maritime, aeronautical and land mobile customers. In another first for Inmarsat this month, Inmarsat approved the world's first commercial satellite telephone installation aboard an aircraft, a Gulfstream IV business jet. The Inmarsat system will support telephone, facsimile and data services for passenger, operational and air traffic control communications for commercial and corporate aircraft by the end of this year. The Inmarsat-2 satellite will provide communications in the frequencies specifically set aside for aeronautical safely communications. "Inmarsat-2 will enable us to broaden the range of services, including communications to even smaller hand portable terminals, and hopefully. continue to reduce communications costs," said Olof Lundberg, Director General of Inmarsat.

After completion of the in-orbit tests, Inmarsat-2 will be drifted eastwards to be placed on station at 64.5 degrees east over the Indian Ocean, greatly boosting the amount of mobile communications capacity available in that region, which extends from the west coast of Africa to central Australia. With a capacity of approximately 250 simultaneous telephone circuits, Inmarsat-2 is about six times more powerful than the Intelsat V Maritime Communications Subsystem that it replaces.

The second Inmarsat-2, due for launch in February 1991 aboard another Delta II launcher, will be placed over the Atlantic Ocean East

region. The third and fourth satellites in the series will be launched by Ariane from Kourou, French Guiana, and will be located over the Pacific and Atlantic Ocean West coverage regions. Inmarsat is currently negotiating with GE Astro for its third generation of even more powerful satellites, to be launched in 1994-1995. For further information, please contact: Elizabeth Hess, Inmarsat, +44 71 387-9089.

SME To Stage Student Robotics/Automation Contest

DEARBORN, Michigan — Robotics International of the Society of Manufacturing Engineers (RI/SME) announces its Fifth Annual Student Robotics/Automation Contest to be held Sunday, April 28, 1991. The event will be hosted by Western Michigan University in Kalamazoo, Michigan.

The largest of such competitions held in North America, this event is expected to draw over 30 schools from throughout the USA and Canada. Junior and Senior High Schools, Community Colleges, and Universities all compete in this nationally recognized contest. "The robotics contest is designed to compliment classroom instruction by giving students the opportunity to apply classroom knowledge in problem-solving and competitive situations," says Thomas J. Meravi, RI/SME's Contest Chairman and Associate Professor of Industry and Technology at Northern Michigan University, Marquette, Michigan.

The public is invited to attend an open viewing session of the student contest entries between 1:00 p.m. and 4:00 p.m. on April 28.

Robotics International of the Society of Manufacturing Engineers (RI/SME), founded in 1980, is the largest individual member association which leads in the generation and exchange of information in robotics to advance the technology for improved productivity and quality of life.

RI/SME is both applications and research oriented and is involved in all phases of robotics research, design, application, installation, human factors, and education and training related to robotics. SME is an international professional society dedicated to advancing scientific knowledge in the field of manufacturing engineering and management. Founded in 1932, SME has 80,000 members in 72 countries and sponsors over 300 senior chapters and 200 student chapters worldwide. For more information contact: SME, One SME Drive, P.O. Box 930, Dearborn, Michigan 48121-0930 Tel: (313) 271-1500 Fax: (313) 271-2861. ❐

BABANI BOOKS

NEW RELEASES

BP 265: MORE ADVANCED USES OF THE MULTIMETER *$11.80*
This book is primarily intended as a follow-up to BP239, and also should be of value to anyone who already understands the basics of voltage testing and simple component testing.

BP 261: A CONCISE INTRODUCTION TO LOTUS 1-2-3 *$11.80*
If you are a PC user and want to get to grips with lotus 1-2-3, then this book will teach you how to do just that in the shortest and most effective way.

BP 248: TEST EQUIPMENT CONSTRUCTION *$11.80*
This book describes in detail how to construct some simple and inexpensive, but extremely useful, pieces of test equipment.

BP 245: DIGITAL AUDIO PROJECTS *$11.80*
This book takes a look at the basic principles involved in converting an audio signal into digital form and then converting it back to an analogue signal again. It also contains practical circuits for constructors to build and experiment with.

BP 251: COMPUTER HOBBYISTS HANDBOOK *$23.80*
This book provides a range of useful reference material in a single source so that it can be quickly and easily located. The subjects covered include microprocessors and their register sets; interfacing serial, parallel, monitor, games and Midi ports; numbering systems; Midi codes; operating systems and computer graphics.

BP 247: MORE ADVANCED MIDI PROJECTS *$11.80*
This book includes circuits for a MIDI indicator, THRU box, merge unit, code generator, pedal, programmer, channeliser and analyser.

BP 260: A CONCISE INTRODUCTION TO OS/2 *$11.80*
This book is for the multitasking PC user that wants to get the most out of their computer in efficiency and productivity.

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This book is for the PC user that is looking for ways to improve their system's efficiency and productivity, while learning something new.

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This book explores many types of enclosures and drive units. Crossover units are also explained, the various types, how they work, the distortions they produce and how to avoid them.

246: MUSICAL APPLICATIONS OF THE ATARI STs *$15.00*
A wide selection of topics is covered, including the internal sound chip, MIDI, applications programs such as sequencing and score writing, etc. Simple but useful add-on projects and MIDI programming.

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Includes remote control systems, transmission links, digital electronics, methods of control, coders, decoders, etc.

BP111: AUDIO *$14.00*
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BP239: GETTING THE MOST FROM YOUR MULTIMETER *$9.00*
This book is aimed at beginners and those of limited experience of electronics. Using the simple component and circuit testing techniques in this book the reader should be able to confidently tackle servicing of most electronic projects.

BP53: PRACTICAL ELECTRONIC CALCULATIONS AND FORMULAE *$11.75*
A book that bridges the gap between complicated technical theory and the "cut and try" method. A good reference book.

BP174: MORE ADVANCED ELECTRONIC MUSIC PROJECTS *$12.00*
Complementing Book PB74, "Electronic Music Projects", BP174 provides projects, such as a flanger, a phaser, mini-chorus and ring modulators, percussion synths, etc. Each project has an Introduction circuit diagram and constructional notes.

BP113: 30 SOLDERLESS BREADBOARD PROJECTS - BOOK 2 *$9.00*
R.A. Penfold
A companion to BP107. Describes a variety of projects that can be built on plug-in breadboards using CMOS logic IC's. Each project contains a schematics, parts list and operational notes.

BP150: AN INTRO TO PROGRAMMING THE SINCLAIR QL *$7.80*
Helps the reader make the best use of the Sinclair QL's almost unlimited range of features. Complements the manufacturer's handbook.

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F.G. Rayer, T. Eng. (CEI), Assoc.IERE
In this book, the newcomer to electronics will find a wide range of easily made projects. Also, there are a considerable number of actual components and wiring layouts, to aid the beginner.

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BP130: MICRO INTERFACING CIRCUITS — BOOK 1 *$9.00*
Aimed at those who have some previous knowledge of electronics, but not necessarily an extensive one, the basis of the book is to help the individual understand the principles of interfacing circuits to microprocessor equipment.

BP131: MICRO INTERFACING CIRCUITS — BOOK 2 *$9.00*
Intended to carry on from Book 1, this book deals with practical applications beyond the parallel and serial interface. "Real world" interfacing such as sound and speech generators, temperature, optical sensors, and motor controls are discussed using practical circuit descriptions.

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This book sets out to show how Electronic Music can be made at home with the simplest and most inexpensive equipment.

BP74: ELECTRONIC MUSIC PROJECTS *$10.00*
R.A. Penfold
Although one of the more recent branches of amateur electronics, electronic music has now become extremely popular. The purpose of this book is to provide the constructor with a number of practical circuits for the less complex items of electronic music equipment, including such things as a Fuxx Box, Waa-Waa Pedal, Sustain Unit, Reverberation and Phaser Units, Tremelo Generator, etc.

BP110: HOW TO GET YOUR ELECTRONIC PROJECTS WORKING *$7.80*
R.A. Penfold
We have all built circuits from magazines and books only to find that they did not work correctly, or at all, when first switched on. This book will help the reader overcome these problems by indicating how and where to start looking for many of the common faults that can occur when building up projects.

BP86: AN INTRODUCTION TO BASIC PROGRAMMING TECHNIQUES *$5.85*
This book is based on the author's own experience in learning BASIC and also in helping others, mostly beginners to programming, to understand the language.

BP234: TRANSISTOR SELECTOR GUIDE *$15.00*
Listings of British, European and eastern transistor characteristics make it easy to find replacements by part number or by specifications. Devices are also grouped by voltage, current, power, etc., includes surface-mount conversions.

BP233: ELECTRONIC HOBBYIST HANDBOOK *$15.00*
A single source of easily located information: colour codes, pinouts, basic circuits, symbols, etc.

BP101: HOW TO IDENTIFY UNMARKED IC's *$1.95*
An unusual and fascinating chart that is highly recommended to all those interested in electronics and which will hopefully pay for itself many times over, by enabling the rEader to use IC's that might otherwise have been scrapped.

BP121: HOW TO DESIGN AND MAKE YOUR OWN PCBs *$5.85*
The purpose of this book is to familiarize the reader with both simple and more sophisticated methods of producing printed circuit boards. The book emphasizes the practical aspects of printed circuit board designs and construction.

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This book describes how to build 25 amateur band aerials. The designs start with the simple dipole and proceed to beam, triangle and even a mini-rhombic.

BP180: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF MODEL RAILWAYS *$9.00*
Shows how home computers can easily be applied to the control of model railroads and other quite sophisticated control. A variety of projects are discussed as well as circuits for train position sensing, signal and electric points control, etc.

BP100: AN INTRODUCTION TO VIDEO *$5.85*
This book is for the person who has just, or is about to buy or rent video equipment but is"nt sure what it's all about.

BP78: PRACTICAL COMPUTER EXPERIMENTS *$5.25*

The aim of this book is to enable the reader to simply and inexpensively construct and examine the operation of a number of basic computer circuit elements and it is hoped gain a fuller understanding of how the mysterious computer "chip" works.

BP185: ELECTRONIC SYNTHESIZER CONSTRUCTION *$9.00*

With this book a relative beginner should be able to build, with a minimum of difficulty and at a reasonably low cost, a worthwhile monophonic synthesizer and also learn a great deal about electronic music synthesis in the process.

BP115: THE PRE-COMPUTER BOOK *$5.85*

Aimed at the absolute beginner with no knowledge of computing, this entirely non-technical discussion of computer bits and pieces and programming is written mainly for those who do not possess a microcomputer but either intend to one day own one or simply wish to know something about them.

BP92: ELECTRONICS SIMPLIFIED - CRYSTAL SET CONSTRUCTION *$5.25*

This is a book written especially for those who wish to participate in the intricacies of electronics.

BP72: A MICROPROCESSOR PRIMER *$5.25*

In an attempt to give painless approach to computing, this inexpensive book will start by designing a simple computer and then the short-comings of this simple machine will be discussed and the reader is shown how these can be overcome. Includes a glossary of microprocessor terms.

BP42: 50 SIMPLE L.E.D. CIRCUITS *$5.85*

Contains 50 interesting and useful circuits and applications, covering many different branches of electronics, using one of the most inexpensive and freely available components.

BP85: INTERNATIONAL TRANSISTOR EQUIVALENTS GUIDE *$9.00*

This book is designed to help the user find possible substitutes for a popular user-oriented selection of modern transistors and includes devices produced by over 100 manufacturers.

BP140: DIGITAL IC EQUIVALENTS AND PIN CONNECTIONS *$15.00*

Shows equivalents and pin connections of a popular user- oriented selection of Digital Integrated Circuits. Includes European, American and Japanese devices.

BP136: SIMPLE INDOOR AND WINDOW AERIALS *$7.00*

People living in apartments who would like to improve shortwave listening can benefit from these instructions on optimizing the indoor aerial.

BP156: AN INTRODUCTION TO QL MACHINE CODE *$10.00*

The powerful sinclair QL microcomputer has some outstanding capabilities in terms of its internal structure. With a 32-bit architecture, the QL has a large address range, advanced instructions which include multiplication and division.These features give the budding machine code programmer a good start at advanced programming methods. This book assumes no previous knowledge of either the 68008 or machine code programming.

BP59: SECOND BOOK OF CMOS IC PROJECTS *$7.80*

This book carries on from its predecessor and provides a further selection of useful circuits, mainly of a simple nature. The book is well within the capabilities of the beginner and more advanced constructor.

BP258 LEARNING TO PROGRAM IN C *$19.00*

This book is a guide to C programming. C statements are introduced and explained with the help of simple, but completely working programs.

BP141: LINEAR IC EQUIVALENTS AND PIN CONNECTIONS *$23.80*

Adrian Michaels

Find equivalents and cross-references for both popular and unusual integrated circuits. Shows details of functions, manufacturer, country of origin, pinouts, etc... includes National, Motorola, Fairchild, Harris, Intersil, Philips, ADC, AMD, SGS, Teledyne, and many others.

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Opens out to Wall Chart approximately 584 X 457mm. Includes many Radio & Electronics Colour Codes in use in UK, USA, Europe and Japan. Covers Resistors, Capacitors, Transformers, Field Coils, Fuses, Battery Leads, etc.

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This book deals mainly with TTL type chips such as the 7400 series. Simple projects and a complete practical construction of a Logic Test Circuit Set are included as well as details for a more complicated Digital Counter Timer project.

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The popular 6502 microprocessor is used in many home computers; this is a guide to beginning assembly language.

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BP84: DIGITAL IC PROJECTS *$7.80*

F.G. Rayer, T. Eng. (CEI), Assoc.IERE.

This book contains both simple and more advanced projects for the reader developing a knowledge of the workings of digital circuits. To help the newcomer to the hobby the author has included a number of board layouts and wiring diagrams.

BP95: MODEL RAILWAY PROJECTS *$7.80*

Electronic projects for model railways are fairly recent and have made possible an amazing degree of realism. The projects covered included controllers, signals and sound effects: stripboard layouts are provided for each project.

BP144: FURTHER PRACTICAL ELECTRONICS CALCULATIONS AND FORMULAE *$15.00*

This book covers many aspects of electronics where a knowledge and familiarity of the appropriate formulae is essential for a fuller understanding of the subject. An essential addition to the library of all those interested in electronics.

BP44: IC 555 PROJECTS *$10.00*

E.A. Parr, B.Sx., C. Eng., M.I.EE.

Every so often a device appears that is so useful that one wonders how life went on before it. The 555 timer is such a device included in this book are Basic and General Circuits, Motor Car and Model Railway Circuits, Alarms and Noise Makers as well as a section on the 556, 558 and 559 timers.

BP94: ELECTRONIC PROJECTS FOR CARS AND BOATS *$7.80*

R.A. Penfold

Projects, fifteen in all, which use a 12V supply are the basis of this book. Included are projects on Windscreen Wiper Control, Courtesy Light Delay, Battery Monitor, Cassette Power Supply, Lights Timer, Vehicle Immobiliser, Gas and Smoke Alarm, and more.

BP49: POPULAR ELECTRONIC PROJECTS by R. A. Penfold *$10.00*

Includes a collection of the most popular types of circuits and projects which will provide a number of designs to interest most electronics constructors. The projects cover a wide range and are divided into four basic types. Radio Projects, Audio Projects, Household Projects and Test Equipment.

BP99: MINI-MATRIX BOARD PROJECTS by R. A. Penfold *$7.60*

Twenty useful projects which can all be built on a 24 X 10 hole matrix board with copper strips. Includes Door-buzzer, Low-voltage Alarm, AM Radio, signal Generator, Projector Timer, Guitar Headphone Amp. and more.

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This book allows the reader to build 21 fairly simple electronic projects, all of which may be constructed on the same printed circuit board. Wherever possible, the same components have been used in each design so that with a relatively small number of components and hence low cost, it is possible to make any one of the projects or by re-using the components and P.C.B. all of the projects.

BP98: POPULAR ELECTRONIC CIRCUITS, BOOK 2 *$9.00*

R.A. Penfold

70 plus circuits based on modern components aimed at those with some experience.

BP127: HOW TO DESIGN ELECTRONIC PROJECTS *$9.00*

Although information on stand circuits blocks is available, there is less information on combining these circuit parts together. This title does just that. Practical examples are used and each is analysed to show what each does and how to apply this to other designs.

BP195: AN INTRODUCTION TO SATELLITE TELEVISION *$15.00*

For the absolute beginner or anyone thinking about purchasing a satellite TV system, the story is told as simply as such a complex one can be.

BP106: MODERN OP-AMP PROJECTS by R. A. Penfold *$7.80*

Features a wide range of constructional projects which make use of op-amps including low-noise, low distortion, ultra-high input impedance, high slew-rate and high output current types.

BP107: 30 SOLDERLESS BREAD-BOARD PROJECTS - BOOK 1 *$9.00*

R.A. Penfold

A "Solderless Breadboard" is simply a special board on which electronic circuits can be built and tested. The components used are just plugged in and unplugged as desired. The 30 projects in this book have been designed to be built on a "Verobloc" breadboard. Wherever possible the components used are common to several projects, hence with only a modest number of components it is possible to build, in turn, every project shown.

BP122: AUDIO AMPLIFIER CONSTRUCTION *$6.75*

A wide circuits is given, from low noise microphone and tape head preamps to a 100W MOSFET type. There is also the circuit for 12V bridge amp giving 18W. Circuit board or stripboard layout are included. Most of the circuits are well within the capabilities of even those with limited experience.

BP179: ELECTRONIC CIRCUITS FOR THE COMPUTER CONTROL OF ROBOTS *$12.00*

The main stumbling block for most would-be robot builders is the electronics to interface the computer to the motors, and the sensors which provide feedback from the robot to the computer. The purpose of this book is to explain and provide some relatively simple electronic circuits which bridge the gap.

BP108: INTERNATIONALDIODE EQUIVALENTS GUIDE *$7.00*

Cross-references European, American and Japanese diode part numbers. Besides rectifier diodes, it includes Zeners, LEDs, Diacs, Triacs, SCRs, OCIs, photodiodes, and display diodes.

BP118: PRACTICAL ELECTRONIC BUILDING BLOCKS — BOOK 2 *$7.60*

R.A. Penfold

This sequel to BP117 is written to help the reader create and experiment with his own circuits by combining standard type circuit building blocks. Circuits concerned with generating signals were covered in Book 1, this one deals with processing signals.

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FEATURE

Using A DMM To Improve Sound System Installations (part1)

by Cliff Asbill, John Fluke Mfg. Co., Inc.

A competent sound system installer must be a jack of all trades. For starters, he or she must have a solid understanding of acoustics, mechanics, electro-mechanics, and electronics. The need to understand acoustics is obvious: it is very difficult to select suitable speaker and microphones locations, or equalize a system, without some understanding of the principles of sound and of electro-acoustical transducers. Likewise, it is important for reasons of safety and sonic performance that the installer possess a basic knowledge of mechanics: having speakers rattle and vibrate — or in our worst nightmare fall on top of people — would be typical consequences of incompetence in this area. And without some understanding of electro-mechanics, an installer is likely to make wiring errors by choosing unsuitable wire, connectors, switching, and/or patching or by installing these critical items incorrectly. So far, all this is obvious. But to many installers it is less obvious why they should learn the basics of electronics. The installer may feel that he does not need a solid grounding in electronics because most major electronic repairs are made on the bench by technicians and proper electronic design is usually the responsibility of the equipment manufacturer and the system designer.

These arguments are true, but they fail to take into account the fact that there are many critical electronic measurements and adjustments that should be made on site. Unfortunately many — perhaps most — installers fail to perform these operations. In fact, one of the most pervasive contributors to faulty sound system installations are errors and oversights resulting from a lack of electronic skills in installers.

The purpose of this article is to acquaint the sound system installer with a few basic electronic and audio concepts, measurements and adjustments. First we will discuss a few relevant electronic formulas and concepts. Most readers will have sufficient background in electronics to easily understand these concepts. The novice, however, should read the accompanying primer entitled "The Basics." Next we will see how to make important measurements using a high quality digital multimeter (DMM). Finally, we will see how the rough data from DMM measurements can be used to make adjustments to the sound system that can greatly improve performance and reliability.

Ohm's Law

The most common electrical formulas used in audio are based on Ohm's law. Most of the basic Ohm's law formulas express the logical relationships between volts, amps, ohms, and power that are implicit in basic electricity. For example, consider these variations: E/R = I, E/I = R, EI = P, VP/R = I, IR = E, P/E = I, I2R=P; where E = voltage, R = resistance, I = current in amps, P = power in watts.

Taking the first formula, E/R = I, we see that with a given voltage, an increase in resistance decreases current: just the sort of logical relationship one would expect.

As an example of the utility of Ohm's law, let's say that an audio engineer totals up the power consumption of a sound system and determines that the total (input) power is 12,450 watts. If all the equipment operates on 120VAC

(which most audio equipment does), we can determine the total current draw on the house AC service by referring to the formula P/E = I. Thus, 12,450 / 120 = 103.75 amps.

Or let's say that one wishes to determine the right value of fuse to protect a loudspeaker. This can only be done only approximately because of the difference between resistance and impedance, and because fuses are more linear in their response to current than loudspeakers. So it may be best to err on the side of caution and choose a lower amperage fuse than the formula indicates. If the loudspeaker has an impedance of 8Ω and a power rating of 200 watts, we can plug these values into I2R=P. We get I28=200 or (through algebraic manipulation) I2=200/8 or I2=25, or I=5. If you feel the loudspeaker is rated conservatively, you could use a five amp fuse.

The Decibel

Many of the theories and formulas that are used in professional audio require a solid understanding of decibel notation. A decibel can be defined as a unit of level equal to ten (or twenty) times the logarithm of the ratio of two powers. There are numerous decibel scales with different zero references. If the scale is based on units of power, velocity or intensity, it will be a 10log decibel scale. If the scale is based on units of voltage or current, then the decibel scale will be 20log.

It should be noted that a decibel is not a fixed unit like a volt, dollar, ounce, or mile. It is a ratio, and the actual "value" of a decibel will vary. For example, on a decibel scale used to measure electrical power, each consecutive decibel (in the positive direction) represents increasingly larger values of wattage. So if we measured the wattage represented by the decibel between -10dbm to -9dbm, we would find that it represents a much higher value of wattage than the decibel between -40dbm to -39dbm. Thus, a decibel scale is a method of expressing very large changes and/or quantities of units in easier to handle quantities. For example, the decibel scale for sound pressure level ranges from about 10db (the threshold of hearing) to 135db (the threshold of pain). A scale of 10db to 135db is an easy scale to handle, but if we expressed that same

The Basics

Everything around us is made up of atoms, and each atom consists of a nucleus containing a certain number of positively charged particles called protons and chargeless particles called neutrons. Around this nucleus orbits electrons; these have an equivalent charge to the protons but are of negative polarity. So long as the number of protons equal the number of electrons, the atom is electrically neutral since the positive and negative charges are in balance. Neutrality is the natural state of an atom, and should an electron depart an outer orbit — thus causing an overall positive charge — the atom will try to return to an electrically neutral state by reacquiring a replacement electron. Similarly, if an atom finds itself with an extra electron in its orbit — thus causing an overall negative charge — the atom will attempt to expel the unwanted particle.

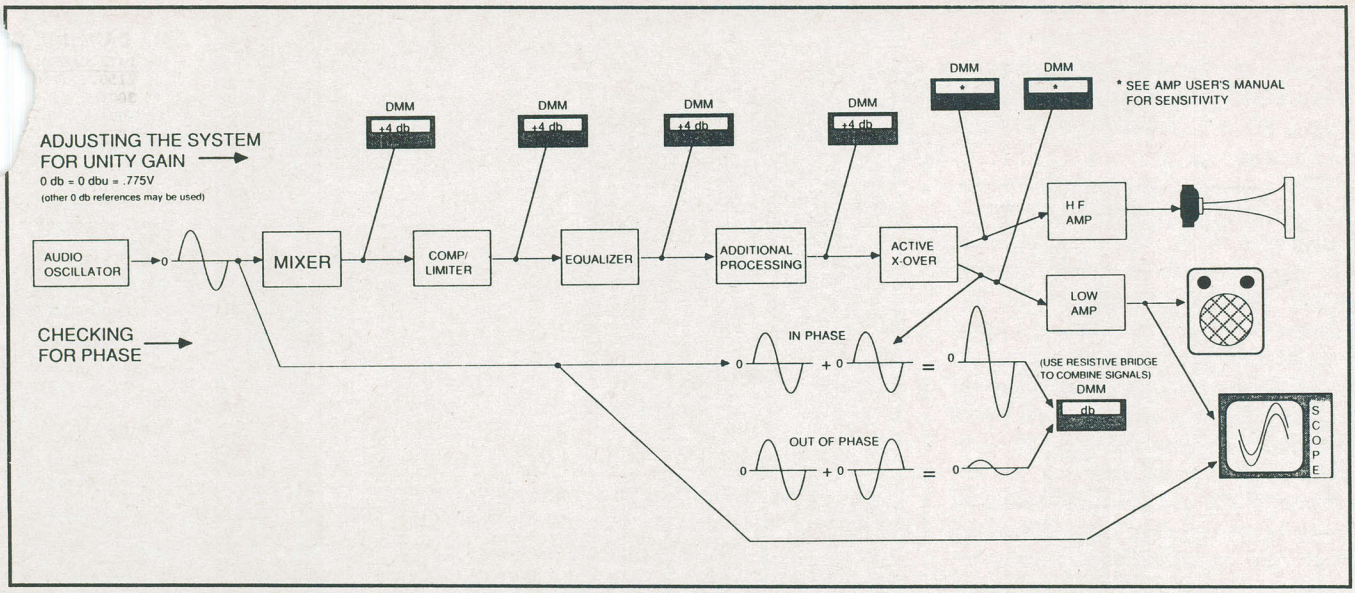
So electricity is simply the migration of electrons from a material that has an excess of electrons to a material that has a shortage of electrons. For example, the negative charged pole of a chemical battery contains a quantity of surplus electrons, and the positively charged pole will have a deficiency of electrons. The greater the numerical imbalance of electrons between the two poles of our battery, the greater the potential between the poles. In order for the battery to do any work in a practical sense (start a car, power a flashlight, etc.) the quantity of electrons needed will be in the billions. In order to express these quantities in manageable numbers we use the coulomb which is a unit representing 6.25 1018 electrons. The measurement of work required to move one coulomb of charge out from the dielectric is the volt (V). (Though beyond the scope of this article, and unnecessary for our understanding here, a technically preferable definition would be: one volt equals one joule [0.7267 foot/pounds] of work per coulomb of charge.) You will often see the symbol E used to represent voltage because voltage can also be described as electromotive force (E or emf).

Regardless of the terminology used to describe the potential to move electrons, it is important to remember that, so far, we have considered potential only — static stress, i.e. electricity at rest. But if we want to power a flashlight or start a car, we need to move electrons from one pole of our battery to the other. To do this, we must provide a circuit consisting of a material that has sufficient free electrons so that when an electron goes in one end, another electron will virtually instantaneously come out the other end — much like a tube full of marbles. Some materials, copper and silver for example, have sufficient free electrons to be considered conductors. Other materials have relatively few free electrons and will obstruct or restrict current flow; these are called insulators or semi-conductors.

Once a circuit providing a sufficient degree of conductivity has been established between the two poles of our battery, electrons will flow. The number of electrons that pass a given point in the circuit can be described as current which we measure in amps (A or I for intensity). One coulomb per second at a given point is equal to one amp.

Most circuits are designed to control and restrict the current flow as part of the process of turning electricity into something useful such as heat, light, motion, etc. The most basic measurement of opposition to current flow is resistance (R) which is expressed in ohms (O). If one amp flows in a circuit for one second and produces .24 calorie of heat, the circuit has a resistance of one ohm. Power (P) is the total amount of work generated by a circuit. Power is expressed in watts (W); and one watt of power equals the work done in one second by one volt of potential in moving one coulomb of charge. In other words, power equals voltage times current.

We have used a battery to demonstrate electrical principles and define terminology. This has been for the sake of clarity; regardless of the actual source of emf (chemical, thermal, photoelectric, or electromagnetic) the principles and terminology are the same. However one important difference between battery power and household power is that batteries provide DC (direct current) and household power is AC (alternating current). In most audio equipment the AC is



scale in terms of fixed units like the dyne (an acoustical unit of force), the scale would range over tens of millions of units.

As an example of how an audio engineer might use a decibel scale, let's say that he had two loudspeakers that put out a total of 100db spl at 100 watts input each, and he needed to know what would be the total spl output if he added 8 identical loudspeakers, assuming that each additional speaker also had 100 watts of input. The formula would be: S1 (original qty of speakers) + S2 (additional speakers) / S1 = R. Find the common log of R and multiply it by 10. Add this decibel number to the original decibel output of S1. So, (2+8) / 2 = 5. Log of 5 is .699. .699(10) = 6.9. 100db + 6.9db = 106.9db. So, the total output of the five speakers will be 106.9db spl. If we had been dealing with voltages, rather than power (in this case acoustical power) we would have used a 20log scale, rather than a 10log scale, and the total output would have been 113.98db.

In audio, common decibel scales include: dba (A weighted, spl), dbb (B weighted, spl scale), dbc (C weighted, spl scale), dbm (zero reference: 1mw across a 600 ohm load), dbv (zero reference: 1 volt), and dbu (zero reference: .775 volt).

Cont'd. in next issue

rectified into DC, but where you are dealing with certain AC signals and circuits (power amplifier outputs feeding loudspeakers, for example) it is important to realize that resistance is opposition to DC, whereas opposition to AC is often measured in impedance (Z and also O). Anyone who has ever measured an 8 Ω speaker with an ohmmeter has discovered that impedance and DC resistance are not the same: the meter will read approximately 6Ω. Thus formulas that call for values of resistance may produce inaccuracies if applied to AC circuits. Generally speaking, however, the field technician need not be troubled by this fact and can safely rely on formulas that call for values of resistance. ❐

Controller, *Cont'd. from page 27*

prove circuit operation. Fig. 6 illustrates how the Remote Control Console was modified for circuit interfacing.

Further Reading and Experimentation:

It is hoped that the reader now has a better understanding of how MOVITs and other intelligent machines function and with this knowledge, he/she can design his or her own machines or systems. There are several good books out on the market that explain how to construct robots or intelligent machines two of which are given here: *Microprocessor Based Robotics* by Mark J. Robillard and *Android Design* by Martin Bradley Weinstein. These two books start from the basics of intelligent machine design and work their way through complex systems design and construction of smart machines. These two books can be found in any good technical library. Heath/Zenith Electronics Self Study Course Microprocessor Applications, Model EE-3405 has several chapters on dc motor control as well as hands-on experiments for practical learning. Contact your local Heath/Zenith Electronic Store for further information on this course and other self-study courses. As for further experimentation with this subject, try to design machines that are capable of detecting and responding to metallic objects or temperature differences. If you have junk box parts available, see if you can design a system where coming in contact with a metallic object, the machine will change direction and turn on an audible or visual alarm. GOOD LUCK ! ! ! ❐

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